THE “*ANOMALIES*” IN HOUSING MARKET: EVIDENCE FROM AUCTION ATTEMPTS

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Summary

Broadly, this thesis attempts to extend the current literature to give a better understanding of loss aversion in housing market. And secondly, it also attempts to examine the price anomaly in real estate auction. Lastly, it intends to bridge the knowledge gap by examining whether observed price "anomalies" diminish in a repeated market environment.

This thesis is motivated based on the greater difficulty of standard economic theory to understand individual choice behavior. In standard economic theory, it relies on expected utility maximization, which implies that economic agents are capable of correctly identifying and maximizing their utility functions. It also assumes unlimited information processing capabilities. In other words, economic agents are rational. For instance, economic theory predicts that the prices that a person will pay to buy and sell an object should be about the same. But numerous experiments have shown that there is a large disparity between selling and buying prices. These are usually term as "anomalies" in economic theory. These "anomalies" depart from the optimal judgment and decision making.

In the recent years, there are numerous efforts to capture psychologically more realistic notions of human nature into economics and finance. This is commonly labeled under the rubric "behavioral economics" and "behavioral finance." The goal of psychological economics and finance is to investigate behaviorally grounded departures from these assumptions that seem economically relevant.

This thesis is mooted on the individual choice behavior by providing it with more realistic psychological foundations. It is based on the behavioral economics theories.

An important groundwork on behavioral economics came from the prospect theory. The theory is developed by Kahneman and Tversky in 1979. It is this theory that paved the development of behavioral economic and finance. The theory showed how judgement under uncertainty departs from the assumption of rationality. Unlike expected utility theory, prospect theory is descriptive and developed in an inductive way from empirical observations. Basically, individuals maximised weighted sum of utilities, which are determined by what Kahneman and Tversky call "value function"

There are three main differences between the value function in prospect theory and utility function in expected utility theory. First, unlike utility function which is concerned with final values of wealth per se, prospect theory is concerned with changes in wealth, relative to a given reference point. Second, the slope of value function is asymmetric between gains and losses; the value function declines more for a given loss than it rises for a gain of the same amount. That is it is concave for gains and convex for losses. However, for utility function, the slope is smooth and concave throughout. Third, for both gains and losses, the marginal value for a change in wealth declines with the magnitude of the change. That is, people behave as if they regard extremely improbable events as impossible and extremely probable events as certain.

As mentioned earlier, one of the thesis objectives is to provide a greater understanding of loss aversion in housing market. Loss aversion is proposed by Kahneman and Tversky (1979) in their prospect theory. This is based on the idea that the mental penalty experienced by an individual or agent associated with a given loss is greater than the mental reward from a gain of the same size. If investors are loss averse, they may be reluctant to realize losses.

Hence unlike the utility function in expected utility theory which is taken to be smooth and concave everywhere, the value function in the prospect theory is S-shaped. It is concave for gains and convex for losses, displaying diminishing sensitivity to change in both directions. Furthermore, it has a kink at zero, being steeper for small losses than for small gains.

So far, many works have been done for loss aversion. However, they are all experimental studies. For instance, the experimental work by Knetsch (Knatch) and Tversky and Kahneman support loss aversion.

Given that the works on loss aversion are carried out using experiments, the results are hence sensitive to:

(1) Who participates and nature of instructions

(2) The types of auction

In the housing market, the research of loss aversion is very limited. The first paper on loss aversion in the housing market is by Genesove and Mayer (2001). Using data on Boston condominium sales, they find that house owners are loss averse using transaction and list prices and time to sale. They also find that loss aversion is not a uniform aspect of participants in housing markets. Basically, investors exhibit less loss aversion than owners.

An often-noted characteristic of housing markets that sets them apart from other asset markets is the positive correlation between housing prices and transaction volume. Stein (1995) argues that credit market imperfections that impose downpayment constraints on buyers can explain this phenomenon. In contrast, Engelhardt demonstrate that loss aversion as an alternative explanation for this phenomenon.

The housing market is a fruitful place to test loss aversion because it is an infrequently traded asset. Unlike common goods such as pens and mugs, a person only gets to buy or sell a property few times in their life. Furthermore, housing is held for both investment and consumption purposes. The transaction data also allow researchers to identify asset acquisition and disposition dates and hence losses are measurable, which has been the challenge for other asset classes.

This thesis uses auction data on housing from Singapore. Auction mechanisms have been extensively used as it provides an excellent platform for a better understanding of human behavior. Unlike many other studies that use experiments, the data set used in this thesis are actual auction data.

In the first part of the thesis, there are two research questions that attempts to examine on loss aversion. Firstly, what is the relevant reference point for evaluating losses in a prospect theory framework? Secondly, how does the sensitivity to loss vary across different types of sellers?

The first part of the thesis attempts to make two primary contributions to the literature. First, we provide empirical evidence on the relevant reference point for prospect theory, specifically we examine whether losses are evaluated relative to the acquisition prices or the highest possible price the owner could have received over the holding period/recent past.

Second, we examine whether there are differences in the extent of loss aversion across types of sellers. Genesove and Mayer (2001) compare owner-occupiers and investors; we extend this to look at the difference between individual (owners) sellers and institutional sellers. Institutional sellers are expected to be less sensitive to loss aversion than are individuals, be it they are more experienced or less emotionally connected to the unit. Individual sellers, on the other hand, are expected to be loss averse.

Our results suggest that loss aversion is evident. Probably our most robust result is that the relevant reference point for measuring the change in the value function is not the initial nominal purchase price, but rather the highest value. There are strong evidences for the reference points to be both the highest price and highest price over the most recent past. Our other findings include that institutions are less susceptible to loss aversion than individuals. Both prices and time to sale time to sale increase more for individuals than for institutions as the likely loss increases. Like

Genesove and Mayer (2001) we get a clear positive relationship between potential loss and the time to sale, where we measure this in a duration framework as the hazard for the probability of sale. We also find that loss aversion is not present for all sellers in housing markets. The motivated sellers do not hold out for higher prices. However, they do take longer to sell their units. A more robust finding is that experienced sellers, that is, institutions selling foreclosed units, are less affected by loss aversion than are individuals.

The second part of the thesis focuses on the price anomalies observed in auction. Ashenfelter and Genesove (1992) attributed their findings for price premium as evidence of the “winner’s curse.” Winner’s curse is a phenomenon where under certain assumptions, successful bidders pay more than an item’s expected market value. On the other hand, Mayer (1995) attributed the discount to be the quick sale under the auction mechanism that results in poorer match between the buyer and house.

Foreclosed properties are usually sold at a discount (Shilling et al., 1990; Forgey et al., 1994; Hardin and Wolverton, 1996, Pennington-Cross, 2006). Hence, one problem in reaching any conclusion from this work might be the difficulty of differentiating the stigma of foreclosure associated with auctioned properties. As the auction data from Singapore consists of both sales by institution and individual owner, this thesis will be able to back out the pure foreclosure effect from the aggregate auction effect. This will provide a clearer understanding on the interaction between the winner’s curse associated with auction and the well documented finding on discount for foreclosed properties.

The research questions that the second part of the thesis attempts to examine include (1) Is there any interaction between the phenomenon of expected premium at auction and discount for foreclosed properties; (2) Is price premium/discount uniform across market participants? Any differences due to bargaining power? (3) Between high and low rise properties, what is the extent of under-maintenance and asymmetric information that cause foreclosed properties to transact at a discount, that is, is there pure discount for foreclosed properties? (4) In the price discovery process, is there any price anomaly for units that are not sold at non-pooled auction but subsequently sold through private negotiation? Has bidders gained experience at auction?

The results shed clear light on the existence of a premium or discount for auction sales, but also the relationship between under-maintenance and asymmetric information on unit quality and the price of units sold at foreclosure.

The third part of the thesis looks into whether anomalies behavior survives in a repeated market environment. In behavioral economics and finance, many anomalies behavior have been found but it is a one-off decision. Hence, some economists question the reliability of the findings as there are also some findings that showed the patterns of behavior that conformed to the standard economic theory. Hence, some economists have thereby argued that anomalies behavior is significant if it survives in an environment in which individuals repeatedly face the same decision problem (Binmore, 1994 and 1999).

In this section, we will focus on loss aversion and the question to ask is basically "Whether loss aversion dissipates with repeated auctions?" We are extending the section on loss aversion to further examine this research question. Interestingly it is found in our research that anomalies do disappear with repeated auctions. However, the adversity of loss is independent of the number of auction attempts.

1.0 Introduction

1.1 Background

This thesis is motivated based on the greater difficulty of standard economic theory to understand individual choice behavior. In standard economic theory, it relies on expected utility maximization, which implies that economic agents are capable of correctly identifying and maximizing their utility functions. It also assumes unlimited information processing capabilities. In other words, economic agents are rational. For instance, economic theory predicts that the prices that a person will pay to buy and sell an object should be about the same. But numerous experiments have shown that there is a large disparity between selling and buying prices. These are usually term as “anomalies” in economic theory (Camerer, 1995 and Starmer, 2000). These “anomalies” depart from the optimal judgment and decision making.

There are many assumptions in economic and financial theory make about human nature that behavioral and psychological research suggests are often importantly wrong. These include the assumptions that people

- Are Bayesian information processors;
- Have well-defined and stable preferences;
- Maximize their expected utility;
- Apply exponential discounting weighting current and future well-being;
- Are self-interested, narrowly defined;
- Have preferences over final outcomes, not changes;

- Have only “instrumental”/functional taste for beliefs and information

In the recent years, there are numerous efforts to capture psychologically more realistic notions of human nature into economics and finance. This is commonly labeled under the rubric “behavioral economics” and “behavioral finance.” The goal of psychological economics and finance is to investigate behaviorally grounded departures from these assumptions that seem economically relevant.

The idea that economists should incorporate behavioral evidence from psychology and elsewhere that indicate systematic and important departures from our discipline’s habitual assumptions is so fundamentally and manifestly good economies (Rabin, 2002).

This thesis is mooted on the individual choice behavior by providing it with more realistic psychological foundations. It is based on the behavioral economics theories.

1.2 Evaluating Behavioral Economics

Stigler (1965) says economic theories should be judged by three criteria: congruence with reality, generality and tractability. Theories in behavioral economics should be judged this way too. The ultimate test of a theory is the accuracy of its predictions and better predictions are likely to result from theories with more realistic assumptions.

Theories in behavioral economics also strive for generality – e.g. by adding only one or two parameters to standard models. Particular parameter values then often reduce the behavioral model to the standard one, and the behavioral model can be pitted against the standard model by estimating parameter values. And once parameter values are pinned down, the behavioral model can be applied just as widely as the standard one.

Adding behavioral assumptions often does make the models less tractable. However, many of the papers show that it can done. Moreover, despite the fact that they often add parameters to standard models, behavioral models, in some cases, can even be more precise than traditional ones which assume more rationality, when there is dynamics and strategic interaction (Camerer and Loewenstein, 2003).

The realism, generality and tractability of behavioral economics can be illustrated with the example of loss aversion. Loss aversion is the disparity between the strong aversion to losses relative to a reference point and the weaker desire for gains of equivalent magnitude. Loss aversion is more realistic than the standard continuous, concave, utility function over wealth, as demonstrated by hundreds of experiments.

Loss aversion has proved useful in identifying where prediction of standard theories will go wrong: Loss aversion can help account for the equity premium puzzle in finance and asymmetry in price elasticities. Loss aversion can also be parameterized in a general way, as the ratio of the marginal disutility of a loss relative to the marginal utility of a gain at the reference point (that is, the ratio of the derivatives at zero); the standard model is the special case in which this “loss aversion coefficient” is one. As the foregoing suggests, loss aversion has proved tractable – although not always simple – in several recent application.

1.3 Standard Economic Theory v. Behavioral Economic Theory

Starting with the 1960s, the findings on psychology began finding its way into the analysis of investment behavior. The goal of behavioral finance is to make economic models better at explaining systematic investor decisions, taking into consideration their emotions and cognitive errors and how these influence decision making.

An important groundwork on ‘anomalies’ behavior came from the prospect theory (Kahneman and Tversky, 1979), which paved the development of behavioral economic and finance. In this theory, it showed how judgment under uncertainty systematically departs from the assumption of rationality as assumed by modern financial theory, using evidence from experimental research. While expected utility theory is axiomatic, their prospect theory is descriptive, developed in an inductive way from empirical observations. In prospect theory, individuals maximized weighted sum of utilities, which are determined by what Kahneman and Tversky call “value function”.

There are three main differences between value function and utility function in expected utility theory.

First, in prospect theory, the decision maker is not concerned with final values of wealth per se, but with changes in wealth, relative to some reference point. This reference point is often the decision maker’s current level of wealth, so that gains and losses are defined relative to the status quo. But the reference level can also be some aspiration level: a wealth level the subject strives to acquire, given his or her current wealth and expectations.

The second difference relative to expected utility theory concerns the value function. In addition to being defined over changes in wealth, this function is S-shaped. Thus it is concave for gains and convex for losses, displaying diminishing sensitivity to change in both directions. Furthermore, it has a kink at zero, being steeper for small losses than for small gains. Utility function in expected utility theory, by contrast, is usually taken to be smooth and concave everywhere.

The third difference is in weights that are not same as probabilities, but are determined by a function of true probabilities which gives zero weight to extremely low probabilities and a weight of one to extremely high probabilities. That is, people behave as if they regard extremely improbable events as impossible and extremely probable events as certain. However, events that are just very improbable (not extremely improbable) are given too much weight; people behave as if they exaggerate the probability. Events that are very probable (not extremely probable) are given too little weight; people behave as if they underestimate the probability (Shiller, 1999). These differences make prospect theory consistent with the experimental evidence.

In essence, the goal of behavioral economics and finance is to increase the explanatory power of economics and finance by providing it with more realistic psychological foundations. As quoted from Rabin (2002), “the idea that economists should incorporate behavioral evidence from psychology and elsewhere that indicate systematic and important departures from our discipline’s habitual and assumptions is so fundamentally and manifestly good economics.”

1.4 Real Estate Auction Data

So far, many works have been done on behavioral economics. However, they are all experimental studies. This is because experimental control is exceptionally helpful for distinguishing behavioral explanations from standard ones. For example, players in highly anonymous one-shot-take-it-or-leave-it “ultimatum” bargaining experiments frequently reject substantial monetary offers, ending the game with nothing (Camerer and Thaler, 1995). Offers of 20% or less of a sum are rejected about half the time, even when the amount being divided is several weeks’ wages or

$400 in the U.S (e.g. Camerer, 2002). Suppose we observe this phenomenon in the field, in the form of failures of legal case to settle before trial, costly divorce proceedings, and labor strikes. It would be difficult to tell whether rejection of offers was the result of reputation-building in repeated games, agency problems (between clients and lawyers), confusion or an expression of distaste for being treated unfairly. In ultimatum game experiments, the first three of these explanations are ruled out because the experiments are played once anonymously, have no agents, and are simple enough to rule out confusion. Thus, the experimental data clearly establish that subjects are expressing concern for fairness. Other experiments have been useful for testing whether judgment errors which individuals commonly make in psychology experiments also affect prices and quantities in markets.

However, the major drawback from experiments is that the results obtained are highly sensitive to the participants and nature of instructions.

Hence, one major contribution of this thesis is to apply insights from psychology and other behavioral sciences using actual auction data. Auction mechanisms have been extensively used as it provides an excellent platform for a better understanding of human behavior. For instance, the studies on willingness to accept (WTA) and willingness to purchase (WTP) disparity by Harless (1989), Kahneman et al. (1990) and Shogren et al. (1994). The results obtained from this data will be cleaner and more straightforward to enable us to understand the behavior of participants.

Furthermore, it will help us rule away the sensitivity of participants and nature of instructions that were experienced in experiments.

Auction data on housing will be used in this thesis. This gives us important new insights into property investors, their investment decisions and the behavior of real estate markets. In addition, unlike previous studies which use auction of common goods such as pens and mugs, it will be interesting to see how human behavior differs when it comes to sale and purchase of a durable good as compared to common goods. Also, housing is held for both investment and consumption purpose. Moreover, unlike common goods, a person only gets to buy or sell a property few times in their life. Furthermore, real estate auction, in particular, has an attraction in that it provides a centralized platform for buyers and sellers in an otherwise highly decentralized real estate marketplace.

In addition, the housing market is a fruitful place to test certain “anomalies” such as loss aversion because transaction data allows researchers to identify asset acquisition and disposition dates, which has been the challenge for other asset classes. Unlike equities, housing is a search market, so certain behavior will manifest itself through both price and time to sale measures.

1.5 Thesis’s Objectives

The objectives of this thesis are basically as follow:

- To identify the relevant reference point for evaluating losses in a prospect theory framework
- To determine whether the sensitivity to loss vary across different types of sellers
- To provide a clearer understanding on the interaction between the winner’s curse associated with auction and the well documented finding on discount for foreclosed properties
- To examine the differences in the extent of price premium/discount between institution sellers of defaulted properties and owner-sellers who view auctions as an alternative sale mechanism
- To identify the extent to which under-maintenance, asymmetric information or bargaining power cause housing units sold because of foreclosure to transaction at a discount

1.6 Structure of Thesis

The rest of the study is organized in the following manner. The next section covers the whole spectrum of literature on behavioral economics and finance. Section 3 gives provides literature review on auction and a discussion on Singapore real estate auction mechanism with brief introduction on the auction data. Section 4 covers the section on loss aversion to address the first two objectives listed above. Section 5 examines the price anomalies observed in auction to address the rest of the objectives. Section 6 seeks to examine the behavioral psychology in repeated market environment. The final section concludes.

2.0 Literature on Behavioral Economics/Finance

There is a whole spectrum of literature on behavioral economics and finance in the last thirty years. For simplicity, this thesis has followed Hirshliefer (2001) approach by classifying the literature into three categories: heuristic simplification, self-deception and emotion loss of control.

2.1 Heuristic Simplification

Heuristic[1] simplification stems from limited attention, memory and processing capacities, and also from unconscious association. It also includes narrow framing – analyzing problems in a too isolated fashion.

Selective triggering of associations causes salient and availability effects. An information signal is salient if it has characteristics that are good at capturing our attention or at creating associations that facilitate recall. *Availability* bias is the tendency to base decisions on the most readily available information, resulting in disproportionately high weight assigned to easily remembered information (Tversky and Kahneman, 1973).

[1] Heuristics is a method of solving problems by evaluating past experiences and moving by trial and error to a solution.

The *halo effect* causes people to misrepresent one characteristics of a person or a thing for another. This effect could cause stock market mispricing. In an efficient market, a stock being good in terms of growth prospects says nothing about its prospects for future risk-adjusted returns. If people misattribute stocks earnings prospect for its return prospects, growth stocks will be overpriced.

The *illusion of truth* is the finding that people are more inclined to accept the truth of a statement that is easy to process. People also tend to choose friends that are just like them. According to evolutionary psychology, people prefer familiar and similar individuals because these were indicators of genetic relatedness. These biases suggest a tendency to prefer local investments.

Magical thinking is the belief in relations between casually unrelated actions or events. A type of magical thinking called illusion of control consists of the belief that a person can favorably influence unrelated chance events.

In *narrow framing*, problems are analyzed in a too isolated fashion, and in context effect the presence of an unselected choice alternative affects which alternative is selected. Mental accounting is a kind of narrow framing that involves keeping track of gains and losses related to decisions in separate mental accounts. It can explain why some people have low paying investments and high interest debts at the same time.

Disposition effect is a tendency to hold on securities that have declined in value and to sell winners. Related is the self-deception theory in which the self-deceiver avoids recognizing losses and regret aversion. According to expected utility theory, utility derives solely from the probability distribution of payoffs resulting from a choice. However, people seem to be regret averse in their choices. They seem to be concerned not just that a choice may lead to low consumption, but that consumption may be lower than the outcome provided by an alternative choice. Regret is stronger for decisions that involve action rather than passivity, an effect sometimes called the omission bias. *Regret aversion* can explain the endowment effect, a prefer for people to hold on to what they have rather than exchange for a better alternative, as with the refusal of individual of individuals to swap a lottery ticket for an equivalent one plus cash. The status quo bias involves preferring the choice designated as the default or status quo among a list of alternatives.

Loss aversion bias suggests that people are more averse to small losses, relative to a reference level, than attracted to the gains of the same size (about twice as much).

Anchoring is the phenomenon that people tend to be overly influenced in their assessment of some quantity by arbitrary quantities in the statement of problem, even when the quantities are uninformative. It means that when estimate is made in the presence of a potential anchor, it tends to be too close to the anchor. Anchoring phenomenon has been confirmed in many experiments, and from them it can be extracted that many economic phenomena are influenced by anchoring, especially valuations in the markets that are inherently ambiguous, such as stock markets. If people form judgments about investments interdependently and are overconfident, their noise trading will cause speculative prices to deviate from their true values.

Representativeness involves assessing the probability of a state of the world based on the degree to which the evidence is perceived as similar to or typical of the state of the world (Hirshleifer, 2001). Kahneman and Tversky (1974) give interesting illustration of this bias. To subjects they presented this description of a person named Linda:

"Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice and also participated in anti-nuclear demonstrations."

When asked which of "Linda is a bank teller" (statement A) and "Linda is a bank teller and is active in the feminist movement" (statement B) is more likely, subjects typically assign greater probability to B. of course, joint probability of these statements cannot be greater than probability of any one of those statements. Representativeness provides a simple explanation. The description of Linda sounds like the description of a feminist – it is representative of feminist – leading subjects to pick B.

Gambler's fallacy is the belief that in an independent sample, the recent occurrence of one outcome increases the odds that the next outcome will differ. For example, when coin is tossed, people tend to think if the toss one was heads, the next one has above the average to be tail.

Clustering illusion appears when people perceive random clusters as reflecting a casual pattern. People mistakenly believe in ‘hot hands’ in basketball, even though empirically actual performance of the players is very close to serially independent. Similarly, they tend to believe that, if a money manager has above the average performance for two years in a row, he has above the average capabilities. There is also evidence that real estate and stock market investors extrapolate trends in forecasting price movements.

Conservatism appears when in the face of new evidence, individuals do not change their beliefs as much as would be rational. Actually, the more useful the evidence, bigger the gap between actual updating and rational updating appears to be. One explanation for conservatism is that processing new information and updating beliefs is costly. There is evidence that information that is presented in a cognitively costly form (information that is abstract and statistical, for example) is weighed less. On the other hand, people may overreact to information that is easily processed (such as scenarios and concrete examples).

Modern finance theory assumes that agents have predetermined well defined preferences. Number of experiments has shown the existence of *preference reversals*. There is also evidence that preferences depend on a way they are presented to the agents. Preference reversals imply the violation of transitivity (x is preferred to y and y is preferred to z, but z is preferred to x). These findings can be applied in the market context. For instance, the idea that the market allocates resources to their best possible use would be undermined if agents’ preferences are affected by the market mechanism itself.

The *disjunction effect* is a tendency for people to want to wait to make decisions until information is revealed, even if the information is not really important for the decision, and even if they would make the same decision regardless of the information. Shiller (1999) argues that the disjunction effect might help explain changes in the volatility of speculative asset prices or changes in the volume of trade of speculative asset prices at times when information is revealed. Thus, for example, the disjunction effect can be in principle explain why there is sometimes low volatility and low of trade just before an important announcement is made, and high volatility or volume of trade after the announcement is made.

2.2 Self Deception

The second category of biases is called self deception biases. These biases are also forms of failure of rationality, which stems from failure to accurately assess one’s internal states. People simply tend to deceive themselves.

Overconfidence bias leads people to believe that their knowledge is more accurate than it really is. For example, it has been documented that people tend to assign high probabilities to the events they think will occur, and low probabilities to the events they think will not occur. Also, they are too optimistic in assigning confidence intervals to the probabilities (e.g. 98% confidence intervals contain the true quantity only 60% of the time). Overconfidence is closely connected to the overoptimism about an individual’s ability to succeed.

If people are overconfident, it means that they fail more often they expect it. Rational learning over time should eliminate overconfidence, which does not always happen due to self-attribution bias. People tend to attribute good outcomes to their own abilities, and bad outcomes due to external circumstances. Self-attribution causes individuals to continue to be overconfident rather than converge to an accurate self-assessment.

Cognitive dissonance is the mental conflict that people experience when they are presented with evidence that their beliefs or assumptions are wrong. It asserts that there is a tendency for people to take actions to reduce cognitive dissonance that would not normally be considered fully rational: the person may avoid the new information or develop contorted arguments to maintain the beliefs or assumptions (Shiller, 1999). For example, in one study, it was shown that people after buying a car avoided reading advertisements for cars they did not choose, but were attracted to advertisements for cars they did choose.

Sunk cost effect is a tendency to be excessively attached to activities for which one has expended resources. This effect may contribute to the tendency of investors to hold on to shares that are losing value for too long.

Similar reasoning can explain *hindsight bias*, when people think they ‘knew it all along’ and the phenomenon of rationalization – constructing a plausible ex post rationale for past choices helps an individual feel better about his decision making skills.

People tend to interpret ambiguous evidence in such way as to be consistent with their own prior beliefs. They give careful scrutiny to inconsistent facts and explain them as due to lack or faulty data-gathering. This *conformity bias* can help maintain self-esteem, consistent with self-deception. Exposure to evidence should tend to cause rational agents with differing beliefs to converge, whereas the attitudes of experimental subjects exposed to mixed evidence tend to become more polarized. Confirmatory bias may cause some investors to stick to unsuccessful trading strategies, causing mispricing to persist.

2.3 Emotions and Self-Control

The third category of biases includes emotions and self-control problems that seem to keep people from rational considerations in their utility maximization efforts.

Ambiguity aversion causes people to make irrational choices. It may increase risk premium over the prediction of CAPM model, when new financial markets are introduced, because of the increased uncertainty about the new economic environment and about resulting outcomes.

Moods and emotions also affect people's propensity to risk. For example, sales of States of Ohio lottery tickets were found to increase in the days following a football victory by Ohio State University. More generally, people who are in good moods are more optimistic is their choices and judgments than those in bad moods. Feelings affect people's perceptions of and choices with respect to risk. Bad moods are associated with more detailed and critical strategies of evaluating information.

Conformity effect is a tendency to conform to the judgments and behavior of others. Related to it, is the false consensus effect – mistaken belief that others share one's belief more than they really do. Self-deception may encourage this phenomenon by making the individual reluctant to consider the possibility that he is making an error. False consensus may also result from availability (since like-minded people tend to associate together). The curse of knowledge is a tendency to think that others who are less informed are more similar in their beliefs to the observer than they really are.

The fundamental *attribution error* is the tendency of individuals to underestimate the importance of external circumstances and overestimate the importance of disposition in determining the behavior of others. In a financial context, such bias might cause observers of a repurchase to conclude that the CEO dislikes holding excess cash rather than the CEO is responding to market undervaluation of the stock. This would suggest market underreaction to corporate events (Hirshleifer, 2001).

3.0 Understanding the Auction Mechanism

3.1 Auction in General

The auction mechanism is gaining acceptance as an effective method of disposal for commodities in general and real estate in particular. Recent research tends to focus on two main thrusts: comparing revenues from different auction formats to revenues from private negotiations (Lusht, 1996; Mayer 1998; Dotzour, Moorhead and Winkler, 1998; Allen and Swisher, 2000), and evaluating the probability of a positive auction outcome (Maher 1989; DeBoer, Conrad and McNamara, 1992; Mayer, 1995; Anglin, 2003; Ong, et al., 2005).

There is no clear consensus on whether prices determined at auctions should be higher or lower than that obtained from private searches. Mayer (1995) developed a search model with a monopolistic seller to show that a quick sale under the auction mechanism results in a poorer “match” between the buyer and the house, thus resulting in a discount compared to a private negotiated sale that would allow more time for the buyer to search for his ideal home. Empirical work by Mayer (1998) using repeat sales to control for quality differences shows that the auction discount increases in market downturns. In contrast, using data for 309 single-family detached houses offered for sale in the Australian housing market from 1988 to 1989, Lusht (1996) finds that privately negotiated sales prices are 5.6% less than auction prices. Quan (2002) develops a theoretical model that allowed for interaction between multiple sellers and the number of bidders, yielding the result that prices determined at auctions will be higher than private negotiated sales. His empirical analysis using data from Texas supports this prediction.

A second area of research on auctions addresses the probability a unit will sell at auction. Mayer (1995) and Anglin (2003) explicitly focus on changes in market conditions and Maher (1989) evaluates the impact of intermediaries on sale probability. Ong, et al, (2005) extend prior work by estimating a model that includes controls not only for location and structure characteristics, but also variables that measure the impact of “turnout” – a proxy for the number of bidders at an auction – and the impact of the auctioning house. Units unsold at auction are the subject of studies by Ashenfelter and Genesove (1992), who show that the prices for identical units were 13% higher than for units subsequently sold in private negotiations. Ong (2005) focuses on properties that were sold through private negotiations after unsuccessfully put up for auction.

A final area of research on auctions that is relevant for this paper is the study of what causes owners to decide whether to bring units to auction. Mayer (1995) explicitly addresses the role of seller search cost. Bulow and Klemperer (1996), focuses on the seller’s bargaining power. Quan (2002) in contrast, addresses the potential buyers, choosing to model their search cost. As Dehring, Dunse, and Munneke (2005) demonstrate, this topic is extremely sensitive to the housing market institutions in a particular location.

3.2 Auction in Singapore

The dominant auction format in Singapore is the English ascending bid auction with a secret reserve price. Auctions have generally been regarded as a last resort method of disposal. The local sentiment toward auctions is similar to that of the US, where auctions are associated with distress properties – foreclosure or mortgagee sales (Asabere and Huffman, 1992). Distress sales are typically put up by the mortgagee, usually a bank or financial institution. Only private properties are put up for auction.[2]

3.3 Auction Data

The data used in this thesis is the real estate auction sales in Singapore. The sample comprises 5,482 private residential auction attempts from 1995Q3 to 2006Q4. This period corresponds to an intense run-up in property prices in 1996 and 2006 followed by the 1997 Asian financial crisis and 2003 (SARS) downturn respectively in the real estate market. This sample covers almost all residential auctions over that period from five auction houses in Singapore. Residential properties in Singapore are typically classified into high-rise (apartment and condominium) and low-rise (terrace, semi-detached, detached houses). The data set includes variables on the

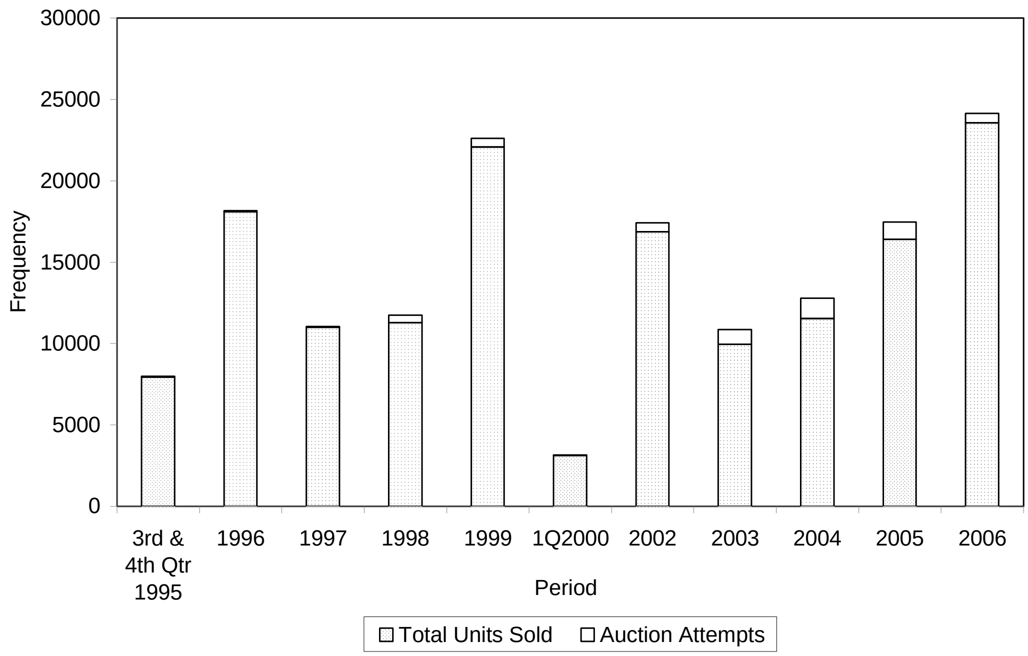
[2] Over the sample period, all public housing flats are financed by mortgages from the Housing Development Board (HDB). As a statutory body responsible for providing affordable housing, HDB often adopts a benign work-out policy regarding delinquency. Foreigners may own private housing only in development is more than 4-storey high. All low-rise housing are hence not available for foreign ownership. Expatriates typically rent rather than own.

location, date of auction, auctioneer, distress sale versus by-owner sale, type of property, tenure, opening price, opening bid and last bid.

3.3.1 Understanding the Auction Data

There was a surge in auction sales following the Asian financial crisis. Although a good proportion comprises mortgagee sales, there has been a discernible increase in owner auctions. Local commentators have suggested that this is due to a diminution of the stigma associated with auctions. This is along with a growing perception among potential buyers that auctions of distress properties provide a good avenue to acquire properties at bargain prices. Buyers and sellers have a better understanding and awareness of the efficiency of the auction system as a method of sale, and auction companies in Singapore have substantially increased the frequency of auctions held each month to meet the growing demand. Even so, the number of properties put up for auction is very low. As Figure 1 shows, auctions comprised 5.5% of the total number of property transactions from 1998 to 2006.

Figure 1: Total Number of Property Transactions and Auction Attempts by Year



Bidders in Singapore are generally not aggressive. The success rate for each bidding session varies from 10% to 50%. The low success rate has been attributed to the flagging performance of property over this period, rather than the appeal of auctions themselves. There may also be a market discovery process at work, where owners use the auction process as a gauge of market interest in their properties and some buyers withhold from biding during an auction in the hope of securing lower transaction prices in post-auction private negotiations. The expectation that private negotiations are more likely to secure a sale will also create an incentive for sellers to set unrealistically high reserve prices for the auctions.

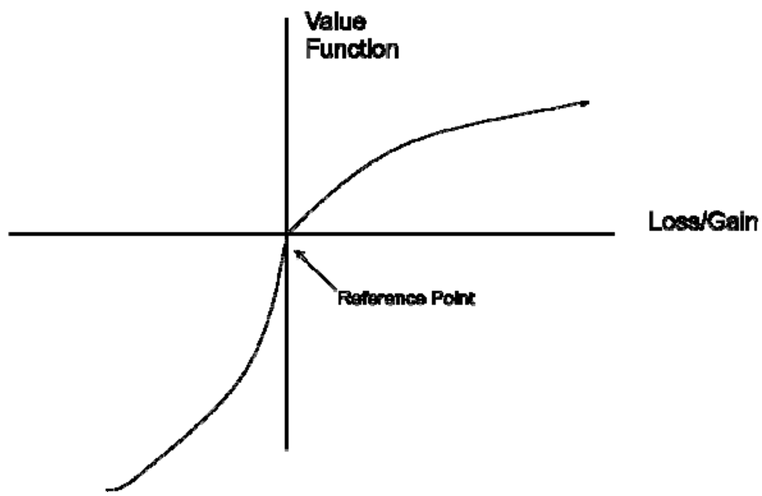
In Singapore reserve prices are disclosed to the auctioneer only on the day of the auction itself, and auctioneers have to rely on appraisals and identify interested buyers during the open-house viewings prior to the auction. It is important to note that the auctioneers and appraisers are two different parties. Since auctioneers only know the reserve price for a property literally hours before the auction, they usually set a realistic opening bid that would convey useful information to interested bidders identified prior to the auction. Auctioneers have anecdotally verified that opening bids are usually good indications of the reserve prices. This is particularly so over the sample period when the real estate market was “soft”.

4.0 Loss Aversion

4.1 Background

Loss aversion is proposed by Kahneman and Tversky (1979) in their prospect theory. This is based on the idea that the mental penalty experienced by an individual or agent associated with a given loss is greater than the mental reward from a gain of the same size. If investors are loss averse, they may be reluctant to realize losses.

Hence, unlike the utility function in expected utility theory which is taken to be smooth and concave everywhere, the value function in the prospect theory is S-shaped. It is concave for gains and convex for losses, displaying diminishing sensitivity to change in both directions. Furthermore, it has a kink at zero, being steeper for small losses than for small gains.



In this framework, the gains and losses are evaluated relative to some reference point. In Tversky and Kahneman (1991) they highlight three features of an individual's value function that must hold for prospect theory to explain loss aversion. First, the magnitude of all gains and losses are evaluated relative to a given reference point, typically assumed to be the acquisition price or an initial endowment. Second, value changes, for given changes in wealth, are asymmetric; the value function declines more for a given loss than it rises for a gain of the same amount. Third, for both gains and losses the marginal value of a change in wealth declines with the magnitude of the change.

4.2 Loss Aversion: "Laboratory"/Experiemental Results

This and other work by Kahneman and Tversky has been subject to considerable analysis, especially experimental studies. The theory and evidence on this class of "anomaly" to the neo-classical model of preferences is presented in Kahneman, Knestsch, and Thaler (1991). Experimental work by Knestch (1989) and Bateman, et. al (1997) show that individuals are more likely to keep their endowed good than engage in a trade for a higher value good.[3] One issue that has emerged is the difference between the behavior of experienced and inexperienced market participants. Knez, Smith and Williams (1985) and Coursey, Hovis, and Schulze (1987) argue that the endowment effect phenomenon is just the result of

[3] Thaler (1980) presents the term "endowment effect," but this is functionally equivalent to prospect theory. In our case the endowment will be the reference point for evaluating gains and losses in house value.

inexperienced market participants, and that as they learn “true” values over time, their behavior would come to better resemble neo-classical theory. Work best associated with List (2003, 2004) and in trying to explain myopic loss aversion in Haigh and List (2005) demonstrates that loss aversion type behavior diminishes with market experience. However, the results are sensitive to experiment design: Knetsch, Tang, and Thaler (2001) find that the endowment effect (loss aversion) decline with experience using a Vickrey auction framework vary depending on the context of the valuation.

Shefrin and Statman (1985) is one of the very first empirical studies that extended the prospect theory to investment. They predict that investors, because of their desire to avoid regret, will tend to hold their losing investments too long and sell their winners too soon and they labeled this tendency the “disposition effect.”

4.3 Housing and Loss Aversion: Literature

Genesove and Mayer (2001) are the very first studies that examine loss aversion in real estate market. They argue that owners who are loss-averse have an incentive to attenuate the loss by choosing a reservation price that exceeds the level they would set in the absence of a loss. Interestingly, empirical evidence further support the loss aversion effect in transaction prices, although the sensitively is lower. The loss aversion explanation persists in spite of the downpayment / liquidity constraints. However, an approach that utilizes listing and transaction prices recognizes that the price is a nonlinear function of property and market characteristics as well as a loss variable. In their studies, the loss aversion is defined as the truncated difference between the purchase price and the predicted price, recognizing that the computed loss variable contains a noise term regarding the over or underpayment when the current owner first bought the property, in addition to an error term for unobserved quality.

In another study by Englehart (2003), he shows that losses among the most leveraged households do not lead to a statistically significant decrease in the probability of moving above and beyond the impact of a loss in general. In other words, it is the loss rather than the tightening of equity constraints that lowers mobility.

Ong, *et al.*, (2004) provide an alternative test of loss aversion explanation for the price-volume puzzle. Instead of observing transaction prices, they shifted their focus to the more easily observable fact of whether a sale occurred or not. They compared the loss aversion sensitivity between foreclosure and non-foreclosure sales. They found that foreclosure sales are less sensitive to losses as the financial institution's main concern is to recover the principle outstanding. On the other hand, the individual sellers are found to be more reluctant to sell when the losses are high which is consistent with the loss aversion hypothesis.

4.4 Housing and Loss Aversion: Why Housing?

Loss aversion is somewhat controversial. While it is an outcome of prospect theory, there has been a challenge to demonstrate it empirically. Most of the research to date relies on experiments.

The housing market is a fruitful place to test loss aversion because it is an infrequently traded asset. Unlike common goods such as pens and mugs, a person only gets to buy or sell a property few times in their life. Furthermore, housing is held for both investment and consumption purposes.

The transaction data allows researchers to identify asset acquisition and disposition dates, which has been the challenge for other asset classes. Unlike equities, housing is a search market, so loss aversion behavior will manifest itself through both price and time to sale measures.

4.5 Research Questions – Loss Aversion

We take loss aversion as a given, and instead focus on what is the relevant definition of loss for sellers. In particular, is it the change in net wealth, the potential sales price relative to the purchase price, or is it more the loss of a gain they might have achieved, the potential sales price relative to the unit's peak price over the holding period or the more recent past. Our second objective is to see how loss aversion behavior varies by seller type. We assume that the Genesove and Mayer (2001) result holds in general and look at two sub-sets of sellers: highly motivated individual sellers and arms' length, experienced institutional sellers.

The two specific research questions that we seek to examine in this thesis are:

(1) What is the relevant reference point for evaluating losses in a prospect theory framework?

(2) How does the sensitivity to loss vary across different types of sellers?

Our data is of a sub-set of sellers in Singapore who put their houses up for auction. One of the advantages in using data from Singapore is that we are able to construct high quality price indexes for the market, have a set of housing units with much less structural variation than is found in North America, and examine behavior over a severe market downturn. The important advantage of using auction data is that it allows us to identify a sample of sellers who have self-selected themselves as motivated to sell. Thus we would expect them to be less loss averse than the sample of all sellers used in existing studies. Within the sample we have two groups, sales by individuals and by institutions, where the latter are sales of foreclosed properties. This latter distinction allows us to also determine whether loss aversion is less likely to occur with more experienced sellers who do not have an emotional investment in a property.

4.6 Contribution

The first part of the thesis attempts to make two primary contributions to the literature. First, we provide empirical evidence on the relevant reference point for prospect theory, specifically we examine whether losses are evaluated relative to the acquisition prices or the highest possible price the owner could have received over the holding period/recent past.

Second, we examine whether there are differences in the extent of loss aversion across types of sellers. Genesove and Mayer (2001) compare owner-occupiers and investors; we extend this to look at the difference between individual (owners) sellers and institutional sellers. Institutional sellers are expected to be less sensitive to loss aversion than are individuals, be it they are more experienced or less emotionally connected to the unit. Individual sellers, on the other hand, are expected to be loss averse.

4.7 Data Description

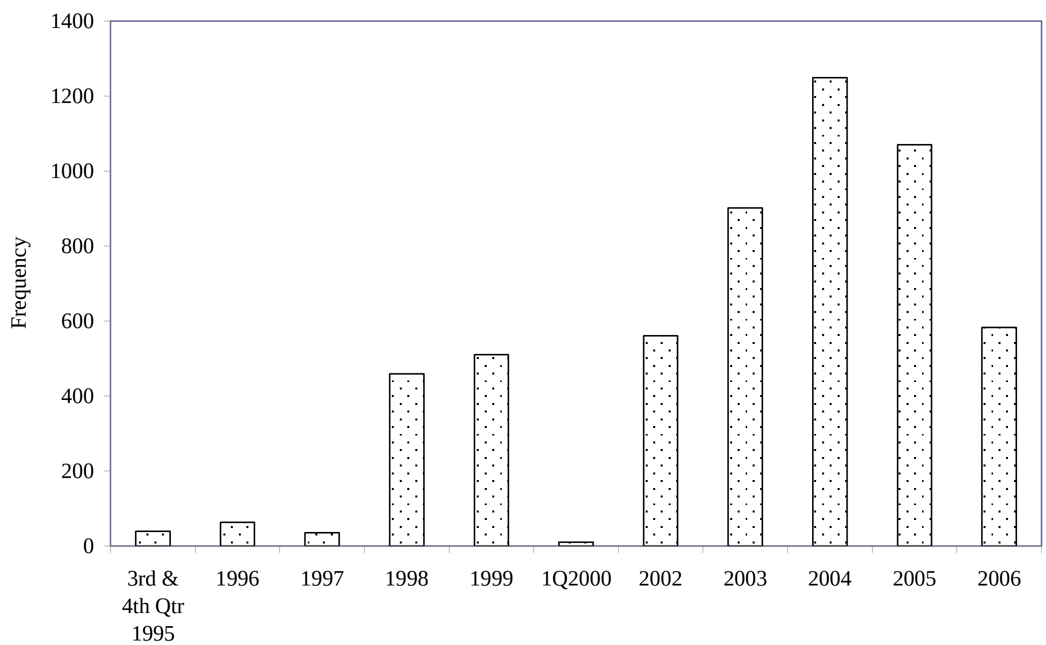
Our sample comprises 5,482 private residential auction attempts from 1995Q3 to 2006Q4, with missing data from 2001Q2 to 2002Q4. This period corresponds to an intense run-up in property prices in 1996 and 2006 followed by the 1997 Asian financial crisis and 2003 (SARS) downturn respectively in the real estate market. Figure 2 shows Singapore house prices with a conventional repeat sales index. This index is constructed using a sample of 28,790 high-rise properties and 8,561 low-rise properties repeat sales transactions from 1990 to 2008, compiled using SISV sales database.

Residential properties in Singapore are typically classified into high-rise (apartment and condominium) and low-rise (terrace, semi-detached, detached houses). While properties in different locations appear to move together, there are differences by type. Hence, we use property type specific indexes in the analysis. Our period has three price peaks and two troughs, allowing for more variation in loss aversion across properties than was the case with Genesove and Mayer’s (2001) single peaked Boston data.

In Figure 3 we show the distribution of auction attempts. Most of the auctions occurred between mid-1998 and the end of-2006, during the trough of the two downturns. The data set includes variables on the unit location, date of auction, auctioneer, sale by individual or foreclosure sale by a financial institution, type of property, whether the land title is fee-simple or leased, opening bid and last bid.

Figure 2: Singapore House Price Indexes

Figure 3: Auctions Attempts by Year



The auction attempt data include a number of properties that were re-auctioned. Thus our 5,482 attempts cover 2,715 distinct properties. 557 properties were sold at the auction, and of the remaining 2,158 properties, 1967 were subsequently sold through private negotiations while 191 remained unsold at the censored date, the end of 2008. The time to sale numbers are quite sensitive to whether a unit is sold at the first auction attempt or is right censored in our data. Figure 4 shows the time to sale for units that are sold in the sample period. The largest mass is for the 3007 sold at the first auction attempt (days to sale equal to 0). The distribution drops off very quickly from the <100 days cell, but there is a very long tail. Figure 5 shows the distribution of "time on the market" defined as the time between their first auction date and the end of our transaction data period in 2008. For the 191 units brought to auction, but not sold, the bulk of the observations are those brought to auction between the 3rd quarter of 1995 and the 4th quarter of 1999, giving censored "time on the market" values in excess of 10 years.

We estimate time to sale as the number of days from the first-auction attempt until sale or the right-censoring date. These data are quite skewed as the mean number, 484 days, greatly exceeds the median, 153 days, because of the 191 units that remain as unsold, censored units (see Figure 5). The auctions are concentrated in 2004, in the price downturn following the 2003 SARs period. Consequently, the auction sales are either by institutions, foreclosed properties, or what we believe to sellers motivated to sell because of financial difficulties brought on by the financial crisis. Unfortunately we have no wealth, debt, or income data on the sellers.

Figure 4: Number of Days from 1st Auction Date to Date of Sale (Excluding properties that remain unsold at censored date)

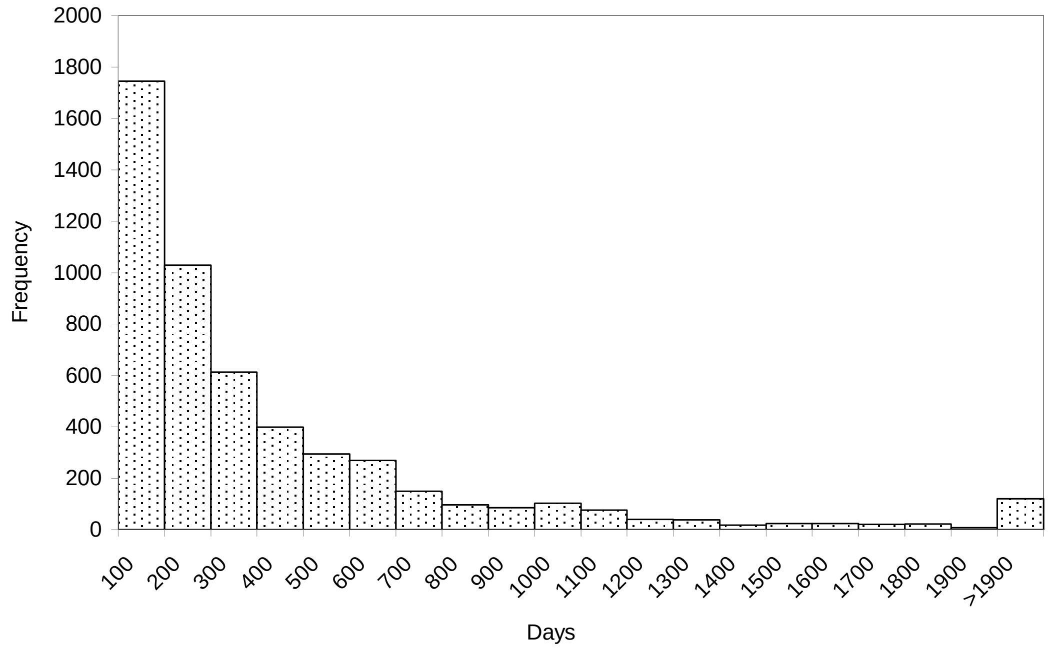


Figure 5: Number of Days from 1st Auction Date to Censored Date (Only for properties that remain unsold at censored date)

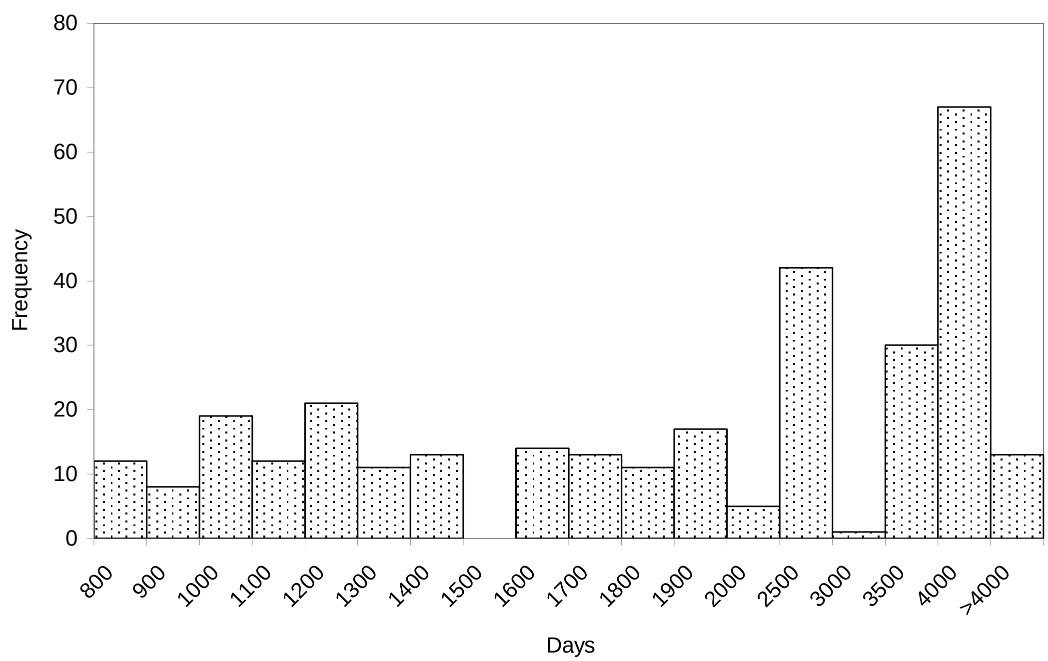


Table 1 provides the summary statistics for the 2715 unique properties. Since we are interested in the difference in loss aversion behavior in pricing and sales strategy based on seller type, we also present descriptive statistics for two sub-samples (sales by institution and by owners).

Table 1: Descriptive Statistics by Property

	All Units		**Sales by institutions (foreclosure sales)**		**Sales by individuals**	
Observations	**2715**		**2107**		**608**	
	Mean	**Std.Dev.**	**Mean**	**Std.Dev.**	**Mean**	**Std.Dev.**
Days from 1st auction date to date of unit sale	400	775	317	665	686	1022
Dummy: =1 if unit is vacant	0.90	0.30	0.92	0.27	0.83	0.38
Dummy: =1 if title is freehold	0.70	0.46	0.67	0.47	0.80	0.40
Dummy: =1 if market prices have fallen for 2 successive quarters	0.76	0.42	0.79	0.40	0.66	0.47
Price index at auction date	111	8.58	111	7.99	113	10.1
Price index at eventual sale	112	8.73	111	8.30	114	9.73
Days from purchase to 1st auction date	2261	23.1	2364	25.5	1906	50.9
Days from highest price over holding period to 1st auction date	1780	19.6	1915	20.9	1313	44.5
Days from highest price over past 2 years to 1st auction date	577	8.03	607	9.10	475	16.4
Dummy: =1 if unit is low rise structure	0.36	0.48	0.33	0.47	0.46	0.50
Dummy: =1 if unit is being sold by institution (foreclosure sale)	0.78	0.42	-	-	-	-
Dummy: =1 if unit is sold at auction	0.21	0.40	0.24	0.43	0.08	0.27
Dummy: =1 if unit is sold at 1st auction	0.14	0.35	0.16	0.37	0.06	0.24
Change in housing price index from1st auction to eventual sale dates	0.01	0.05	0.004	0.04	0.01	0.07
Loss aversion (relative to	0.09	0.07	0.09	0.07	0.06	0.06

price index at purchase date)						
Loss aversion (relative to highest price index over holding period)	0.15	0.07	0.16	0.07	0.12	0.08
Loss aversion (relative to highest price index over 2 years prior to sale)	0.05	0.06	0.05	0.05	0.06	0.07

Notes: Loss aversion is censored at zero for those units for whom the price index at time of sale or censoring is greater than the value at the reference point. We then use the absolute value of the loss.

Table 2: Descriptive statistics by Auction Attempt (5482 Observations)

	Mean	Std.Dev.	Minimum	Maximum
Dummy: =1 if unit is sold at auction	0.10	0.30	0	1.00
Dummy: =1 if unit is vacant	0.93	0.25	0	1.00
Dummy: =1 if title is freehold	0.69	0.46	0	1.00
# of previous auction attempts	1.42	2.41	0	25.00
Dummy: =1 if market prices have fallen for 2 successive quarters	0.82	0.39	0	1.00
Price index at auction date	110	7.79	97.2	140
Days from purchase to 1st auction date	2341	1168	21.0	5937
Days from highest price over holding period to 1st auction date	1900	969	0	3879
Days from highest price over past 2 years to 1st auction date	596	399	0	3878
Dummy: =1 if unit is low rise structure	0.33	0.47	0	1.00
Dummy: =1 if unit is being sold by institution (foreclosure sale)	0.85	0.36	0	1.00
Loss aversion (relative to price index at purchase date)	0.09	0.07	0	0.22
Loss aversion (relative to highest price index over holding period)	0.16	0.07	0	0.31
Loss aversion (relative to highest price index over 2 years prior to sale)	0.05	0.05	0	0.29

The properties put up for auction are mostly vacant, constituting 90% of the total observations. Freehold properties make up the bulk of the sample. High rise properties make up the majority of the auction attempts. Approximately 75 percent of the properties are offered for sale by institutions, but they constitute 85 percent of the auction attempts as they are more likely to attempt to auction again if the first attempt ended in failure.

The state of the market variable suggests that 76% of properties were first put up for auction during a down market. The average holding period from purchase to first auction attempt is about 2261 days. Only 14 percent of the properties are sold at first auction.

On the average, owners suffered a 9% loss from their original purchase price and 15% from the highest peak observed during their holding period. If we take the most recent losses (past 2 years prior to sale), owners suffered an average loss of 5%. The highest loss is about 31% over the holding period and 29% over the 2 years prior to sale.

In Table 1 we also compare properties put up for auction by institutions with those offered by individual owners. For nearly all of the variables the differences in the means are statistically different from zero. The differences are greatest in magnitude for the days from first auction date to sale, principally because of the large difference in the probability that a unit is sold at auction. On average, institutions sell their units in 317 days to sell their properties, while it takes 686 days for individual owners. This provides some anecdotal evidence of difference in behavior between financial institution and individual owners.

4.8 Methodology

Prospect theory suggests that when faced with choices involving simple two and three outcome lotteries, people behave as if maximizing an S-shaped value function. Hence critical to this value function is the reference point from which gains and losses are measured. As Kahneman and Tversky (pp, 286 – 287) put it, “In most cases, the status quo is taken as the reference point, but there are situations in which gains and losses are coded relative to an expectation or aspiration level that differs from the status quo.” The reference point used for the past studies of loss aversion using housing market data is the purchase value. Given that property is usually held for a long time over a wide range of prices, the purchase date may be only one determinant of the reference point. The price path may also affect the level of the reference point. For measuring the magnitude of loss aversion we use the change in the market price index. Our defense of this approach is presented in Appendix A.

This study uses three reference points – price at purchase, the peak property price over the owner’s holding period and the peak property price over the recent past, which we define as the past two years. To take account of the same market peak that we observed for part of our samples, the loss aversion relative to the highest price over the holding period is measured as a function of purchase value, that is, it is taken to be $\frac{\text{highest price}}{\text{purchase price}} - \frac{\text{current price}}{\text{purchase price}}$. In addition, we examine the reaction of the owners to the most recent losses. The purchase date in our sample is traced using the Singapore Institute of Surveyors and Valuers (SISV) sales database, which encompasses all residential real estate transactions in Singapore since 1988.

We use three approaches to measure the effect of loss aversion on auction sales. First we test for the effect of loss aversion on a unit’s sales price, either the price that the properties are sold either at the auction itself or via private negotiated sales after failure to sell at the auction. We recognize that there may be a sample selection issue in that we are focusing on properties that are put up for auction, as well as those that sell. We applied a Heckman correction for sample selection. However, the coefficients on the inverse mills ratio in the 2nd stage OLS regressions on sales price and time to sale were consistently statistically not different from zero, so we reject any problems of bias.[4] In this and the subsequent two tests we control for seller type and introduce an interaction between seller type and the measures of loss aversion to see if there is any evidence of variation in sensitivity to loss across seller types.

Housing markets clear via both price adjustment and time on the market. Our second approach is to test for an effect of our different loss aversion measures on the number of days from the first auction where the property has been put up for auction to the point where it is sold, either at the auction itself or via private

[4] We used Lee’s (1982) 2-stage procedure by estimating a first stage probit regression on a data set of 13,225 properties, of which 12,408 properties that are sold via private negotiated sales (does not include those that are sold via private negotiated sales after failure to sell at the auction). Variables included in the probit model are dummies for low rise and freehold properties, year and neighborhood (postal code) dummies, floor area, volume of sales in that quarter and change in price relative to purchase date.

negotiated sales. This is similar to the research on time on market and we hypothesize that owners who are loss averse should have a higher reserve prices and be less likely to sell their properties if they were to incur a loss, hence their units should remain a longer time on the market. We employ a proportional hazard model of duration for this test. Our third approach takes advantage of our auction data to test a variant of the probability of sale analysis, whether a unit is sold at auction or not. Since most successful auction sales occur at the first auction this is analogous to testing whether time to sale equals zero.

To control for market condition, we specify a state-of-the-market variable that indirectly affects the sentiment of property buyers and hence affects the probability of a sale (Mayer, 1995). The state-of-the-market variable is a dummy variable that takes on a value of zero if the auction occurred in a quarter following two previous successive quarters of negative growth in property prices. We also introduce *year* dummy variables to control for the timing of the auction (Vanderporten, 1992) and the absolute value of the property price index that we observed at the auction date. We include a number of property characteristic variables: title type (freehold or leasehold), whether the unit is currently vacant, is the property in a high rise or low rise property (terrace (townhouse), or detached unit), and property size, either floor or lot area or both. To capture neighborhood amenities we include postal area fixed effects (twenty eight separate districts). We also capture the number of previous auction attempts to account for repeat auctions.

A central element of our analysis is whether loss aversion varies across individuals. This may be because of market experience, as suggested by theoretical work or some other factor. We distinguish between experienced trades, those sales conducted by institutions, and sales by an individual owner. We expect the individuals responsible for selling the units on behalf of the financial institutions to have more experience with the market than will individuals selling their own units. However, because sales by financial institutions are typically foreclosure sales, the institutions may only be concerned about the value of their outstanding loan, the appropriate reference point maybe the loan's current value. The institutional setting suggest otherwise. Borrowers in Singapore are liable for negative equity in the event of mortgage default.[5] Consequently, lenders owe a fiduciary duty to obtain the best price for defaulted owners.[6] This is in addition to the incentive to cover outstanding loan principals. Given that institutional sellers have similar incentives as owner-sellers to obtain the best price possible, any empirical differences in loss aversion behavior between institutions and owners may be attributed to experience or proclivity to loss aversion.

Other control variables that are used are the number of days from either the purchase or highest property price index (PPI) value observed during the holding period to date of first, change in PPI from first auction to eventual sale, number of

[5] More precisely, negative equity for Singapore mortgages occurs when the sale proceeds net of repayment of the CPF principal sum plus CPF savings used to pay the legal costs, stamp duty and survey fees is *less* than the loan principal (CPF Residential Property Scheme). This policy has been amended since September 2002.
[6] Owners who perceive that their properties are sold at lower than market prices can and do file legal suits against the bank. For this reason, many banks have to show due diligence in trying to get the best price possible.

days from date of first auction to censored date and also a dummy variable to indicate properties that are not sold at the auction.

4.9 Results

Our first test is whether owners exposed to nominal losses in their properties hold out for higher transactions prices. As per the treatment in Genesove and Mayer (2001), all else being equal, if loss aversion is present, the eventual sales price should rise with the loss exposure (positive coefficient on the loss aversion measure), but the marginal effect should decline with the size of the loss (negative coefficient on the square of the loss aversion measure). We present the results in Table 3A and 3B. These are separate for high and low rise units. The need to exclude units that do not transact in the observation period restricts the total sample size to 2520 observations. As noted above, loss aversion is measured as the change in the overall market index between three separate reference point date and the sales date. We see evidence of loss aversion behavior around sales price for both high and low rise units. For all units, it is clear that the choice of reference point matters.[7]

In our data, loss aversion does not affect sales prices when the reference point is the initial purchase price. Regressions (1) and (4) use the change in the market price index between the unit’s purchase and sales dates to measure loss aversion for high

[7] These regressions include year and neighborhood (postal area) dummies; unit characteristics such as whether the unit is vacant, title is freehold, unit size (high-rise only), and lot size (low rise only); and auction variable is # of previous auction attempts. Results on property type and size are sensible and robust across specifications within a type class

and low rise units respectively. In both cases, the standard errors of coefficient estimates exceed the point estimates. Sellers appear to be more sensitive to forgone wealth opportunities than an actual loss. Sales prices for all unit types rise with loss aversion when the reference point to measure this loss is the highest possible value achievable over the whole period and over the last 2 years prior to sale. In regressions (2), (3), (5) and (6), for both high- and low-rise units, when the reference point is the highest achievable price over the whole period and the last 2 years prior to sale, the coefficient estimates on loss aversion are of the expected signs and either statistically different than zero at the 10 percent level or close to this criteria. The statistically significant negative coefficients in regressions (5) and (6) on the square of the loss aversion measure is consistent with prospect theory (Kahneman and Tversky, 1979) that the marginal value declines with the magnitude of loss.

Table 3A: Regressions on Log Sales Price (High Rise)

	(1)	(2)	(3)
	High Rise	**High Rise**	**High Rise**
Constant	5.90*** (0.04)	5.95*** (0.05)	5.96*** (0.05)
Dummy: =1 if market prices have fallen for 2 successive quarters	-0.05** (0.02)	-0.05* (0.02)	-0.03 (0.02)
Days from Reference Point to 1st Auction Date	-0.00001*** (0.000004)	-0.00001 (0.00001)	-0.000001 (0.00001)
Days from 1st Auction Date to Eventual Sale	0.00002* (0.00001)	0.00002* (0.00001)	0.00002** (0.00001)
Dummy: =1 if unit is being sold by institution (foreclosure sale)	-0.06*** (0.02)	-0.10*** (0.04)	-0.10*** (0.02)
Dummy: =1 if unit is sold at auction	-0.02 (0.02)	-0.02 (0.02)	-0.02 (0.02)
Dummy: =1 if unit is sold at 1st auction	0.04** (0.02)	0.04** (0.02)	0.04** (0.02)
Change in housing price index from1st auction to eventual sale dates	0.73*** (0.14)	0.89*** (0.13)	0.91** (0.50)
Reference Point for Loss Aversion Measure	**Purchase Price**	**Highest Over Holding Period**	**Highest Over Last 2 Years**
Loss aversion measure	0.41 (0.48)	0.90* (0.55)	1.18** (0.50)
Interaction: Loss aversion x sold by institution	-0.30 (0.53)	-0.66 (0.53)	-0.69 (0.53)
Loss aversion^2	-1.15 (2.75)	-1.76 (1.75)	-2.21 (1.71)
Interaction: Loss aversion^2 x sold by institution	1.35 (2.95)	0.95 (1.84)	1.07 (1.83)
Number of Observations	1632	1632	1632
R-Squared	0.54	0.53	0.53

Standard errors are in parentheses. All the models include year and neighborhood (postal area) dummies; hedonic variables include whether unit is vacant, title is freehold, unit size (high-rise only), and lot size (low rise only); and auction variable is # of previous auction attempts but are not in the table.

***, ** and * denote significance level at 1%, 5% and 10% respectively

Table 3B: Regressions on Log Sales Price (Low Rise)

	(4)	**(5)**	**(6)**
	Low Rise	**Low Rise**	**Low Rise**
Constant	5.91*** (0.04)	5.79*** (0.06)	5.81*** (0.06)
Dummy: =1 if market prices have fallen for 2 successive quarters	-0.01 (0.02)	-0.02 (0.02)	-0.17 (0.02)
Days from Reference Point to 1st Auction Date	0.000002 (0.00002)	-0.00001 (0.00001)	-0.00001 (0.00003)
Days from 1st Auction Date to Eventual Sale	0.00002* (0.00001)	0.00002 (0.00001)	0.00002* (0.00001)
Dummy: =1 if unit is being sold by institution (foreclosure sale)	-0.03 (0.02)	-0.04 (0.04)	-0.04 (0.04)
Dummy: =1 if unit is sold at auction	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)
Dummy: =1 if unit is sold at 1st auction	-0.02 (0.02)	-0.02 (0.02)	-0.02 (0.02)
Change in housing price index from1st auction to eventual sale dates	0.48*** (0.14)	0.48*** (0.14)	0.47*** (0.14)
Reference Point for Loss Aversion Measure	**Purchase Price**	**Highest Over Holding Period**	**Highest Over Last 2 Years**
Loss aversion measure	0.16 (0.57)	1.62** (0.64)	1.43** (0.59)
Interaction: Loss aversion x sold by institution	-0.57 (0.66)	-1.29** (0.63)	-1.27** (0.63)
Loss aversion^2	-2.68 (3.52)	-5.10** (2.03)	-4.74** (1.99)
Interaction: Loss aversion^2 x sold by institution	4.31 (4.02)	4.44** (2.15)	4.37** (2.15)
Number of Observations	888	888	888
R-Squared	0.67	0.67	0.67

Standard errors are in parentheses. All the models include year and neighborhood (postal area) dummies; hedonic variables include whether unit is vacant, title is freehold, unit size (high-rise only), and lot size (low rise only); and auction variable is # of previous auction attempts but are not in the table.

***, ** and * denote significance level at 1%, 5% and 10% respectively

In general, institutions are selling units at a lower price. However, this result is only statistically different from zero for high-rise units in regressions (1) to (3). The prices at which institutions sell units appear to be somewhat less affected by losses than is the case for individual owners: the coefficients on the interaction between loss aversion and sold by institution are negative in all the six regressions and the point estimates are statistically different from zero in regressions (5) and (6).

In Table 4A & 4B we present results for the test of the relationship between loss aversion and time to sale. The empirical specification uses a proportional hazard model, so that the coefficients reflect the hazard of sale, rather than days to sale. Thus a positive coefficient means the probability of sale, contigent upon not having sold to date, increases in the variable. This is analogous to a decrease in the expected time to sale. There is right censoring in the data for the 191 of our 2715 units that do not sell in the sample period, which closes in Dec. 2008. Genesove and Mayer (2001) were the first to identify the expect effects of loss aversion on sales time in search markets such as housing. We find support for Genesove and Mayer (2001) in regressions (2) and (3) where the loss aversion is measured relative to both the highest price and highest price over the recent past. This result is statistically different than zero at the 5 percent level. For the purchase point of reference, the coefficient is also negative, but with smaller point estimates.

Institutions tend to sell units more quickly as observed in regressions (1), (2) and (3) where the coefficients on sale by institutions are statistically significant. The results also indicate that they are less affected by loss aversion than are individual sellers. Relative to individuals, increases in the perceived loss increase the sale hazard (accelerate the time to sale) for institutions relative to the hazard for units sold by individuals: the coefficient on the loss aversion by institution interaction variable is negative and statistically different than zero in regressions (2) and (3). However, institutions themselves do not display explicit loss aversion behavior. When the sample is limited to sales by institutions in regression (4) and (5); the coefficient on potential loss is far from statistically different than zero.

One interesting point from Tables 3A & 3B and 4A & 4B is that institutions tend to sell at a faster pace as compared to owners when faced with losses, but they do not necessarily sell at a lower price than the owners. In other words, institutions wanted to recoup their losses at the soonest possible but still appear to sell at the highest price achievable. This result is supportive of the claim that financial institutions follow their fiduciary duty to exercise care in trying to obtain the best price possible for defaulted properties.

In Table 5A & 5B we look at a variant of the time to sale questions, by examining the role loss aversion may play in influencing whether a property sells at the first attempted auction or not.[8] Sale at auction is a likely explanation for the shorter mean selling times for units sold by institutions, as those units sold at first auction comprise a mass at zero in the time to sale data. Whether a unit is sold at auction depends both on interest in the property and on the opening minimum bid set by auctioneer. We presume the latter reflects the reservation price set by the seller as

[8] This follows work by Ong, Lusht, and Mak (2005) on this question.

the auctioneer learns of the seller's reservation price on the day of the auction. Consistent with the treatment in the sale hazard model in Table 4A & 4B, we expect that the probability of a unit being sold at auction falls with loss aversion, reflecting the higher reservation prices associated with loss aversion. This expectation is confirmed in regressions (2) and (3) where the coefficient on loss aversion is negative and statistically significant, reflecting a lower probability of sale at auction. Here again we find that the relevant reference point is not the purchase price, but the highest price achieved since purchase, or in the past two years.

We also find evidence that the probability a financial institution sells a unit at auction increases with the perceived loss. Though the coefficient estimates for institutions (the interaction effect) are not statistically different from zero in regressions (1), (2) and (3), when we limit the sample to sales by institutions in regressions (5) and (6), the coefficient estimate for loss aversion in regression (5) is positive and statistically different from zero.

To conclude, our results suggest that loss aversion is evident. Probably our most robust result is that the relevant reference point for measuring the change in the value function is not the initial nominal purchase price, but rather the highest value. There are strong evidences for the reference points to be both the highest price and highest price over the most recent past. Our other findings include that institutions are less susceptible to loss aversion than individuals. Both prices and time to sale time to sale increase more for individuals than for institutions as the likely loss increases. Like Genesove and Mayer (2001) we get a clear positive relationship between potential loss and the time to sale, where we measure this in a duration framework as the hazard for the probability of sale. We also find that loss aversion is not present for all sellers in housing markets. Sellers, self-selected to be motivated sellers do not hold out for higher prices. However, they do take longer to sell their units. A more robust finding is that experienced sellers, in our data institutions selling foreclosed units, are less affected as loss aversion increases in their time to sale and likelihood of sale at auction than are individuals.

Table 4A: Time to Sale – All Sales
(Proportional Hazard Model)

	(1)	(2)	(3)
		All Sales	
Dummy: =1 if market prices have fallen for 2 successive quarters	0.01 (0.15)	0.007 (0.15)	0.01 (0.17)
Price index at auction date	-0.06* (0.03)	-0.06** (0.03)	-0.05 (0.03)
Price index at eventual sale	0.11*** (0.03)	0.11*** (0.03)	0.10*** (0.03)
Dummy: =1 if unit is low rise structure	0.71** (0.31)	0.79** (0.37)	0.68* (0.36)
Dummy: =1 if unit is being sold by institution (foreclosure sale)	0.44*** (0.16)	0.99*** (0.25)	0.87*** (0.17)
Dummy: =1 if unit is sold at auction	-1.83*** (0.16)	-1.81*** (0.16)	-1.81*** (0.16)
Change in housing price index from 1st auction to eventual sale dates	8.65*** (2.60)	8.75*** (2.58)	10.3*** (2.63)
Reference Point for Loss Aversion Measure	**Purchase Price**	**Highest Over Holding Period**	**Highest Over Last 2 Years**
Loss aversion (relative to price index at purchase date)	-0.94 (2.66)		
Interaction: Loss aversion (relative to purchase price) x sold by institution	2.43 (1.63)		
Loss aversion (relative to highest price index over holding period)		-4.87*** (1.66)	
Interaction: Loss aversion (relative to highest price index over holding period) x sold by institution		5.01*** (1.63)	
Loss aversion (relative to highest price index over 2 years prior to sale)			-8.08*** (2.74)
Interaction: Loss aversion (relative to highest price index over 2 years prior to sale) x sold by institution			8.92*** (1.92)
Number of observations	2715	2715	2715
Likelihood ratio	-3293	-3290	-3283

Dependent Variable: Number of Days from 1st Auction to Eventual Sale Either by Auction or Private Negotiated Sale. Standard errors are in parentheses. All the models include year and neighborhood (postal area) dummies. Other variables included in the regression, but not shown here is the interaction between loss aversion and low rise and dummy for unit is not occupied.
***, ** and * denote significance level at 1%, 5% and 10% respectively.

Table 4B: Time to Sale – Institutional Sales Only
(Proportional Hazard Model)

	(4)	**(5)**
	Institution Sales Only	
Dummy: =1 if market prices have fallen for 2 successive quarters	0.41** (0.16)	0.09 (0.19)
Price index at auction date		
Price index at eventual sale	0.14*** (0.02)	0.07*** (0.02)
Dummy: =1 if unit is low rise structure	2.02*** (0.36)	0.96*** (0.36)
Dummy: =1 if unit is being sold by institution (foreclosure sale)		
Dummy: =1 if unit is sold at auction	-1.73*** (0.17)	-1.56*** (0.18)
Change in housing price index from 1st auction to eventual sale dates		14.0*** (2.34)
Reference Point for Loss Aversion Measure	**Highest Over Holding Period**	**Highest Over Last 2 Years**
Loss aversion (relative to price index at purchase date)		
Interaction: Loss aversion (relative to purchase price) x sold by institution		
Loss aversion (relative to highest price index over holding period)	0.45 (1.10)	
Interaction: Loss aversion (relative to highest price index over holding period) x sold by institution		
Loss aversion (relative to highest price index over 2 years prior to sale)		0.94 (2.18)
Interaction: Loss aversion (relative to highest price index over 2 years prior to sale) x sold by institution		
Number of observations	2107	2107
Likelihood ratio	-2612	-2589

Dependent Variable: Number of Days from 1st Auction to Eventual Sale Either by Auction or Private Negotiated Sale. Standard errors are in parentheses. All the models include year and neighborhood (postal area) dummies. Other variables included in the regression, but not shown here is the interaction between loss aversion and low rise and dummy for unit is not occupied.

***, ** and * denote significance level at 1%, 5% and 10% respectively.

Table 5A: Probability Property Will Be Sold at Auction – All Sample (Logit for All Auction Attempts)

	(1)	(2)	(3)
	All Sample		
Constant	1.10 (2.67)	-7.68*** (3.10)	-8.43** (3.75)
Dummy: =1 if title is freehold	-0.001* (0.0004)	-0.001* (0.0004)	-0.001* (0.0004)
# of previous auction attempts	-0.17*** (0.04)	-0.20*** (0.04)	-0.18*** (0.04)
Dummy: =1 if market prices have fallen for 2 successive quarters	0.55*** (0.18)	0.49*** (0.18)	0.51*** (0.20)
Price index at auction date	-0.01 (0.02)	-0.04 (0.02)	-0.05 (0.03)
Days from purchase to 1st auction date	0.0002*** (0.0001)		
Days from highest price over holding period to 1st auction date		0.0002 (0.0001)	
Days from highest price over past 2 years prior to sale to 1st auction date			0.0002 (0.0001)
Dummy: =1 if unit is low rise structure	0.03 (0.36)	0.74 (0.47)	0.77* (0.43)
Dummy: =1 if unit is being sold by institution (foreclosure sale)	1.58*** (0.25)	1.84*** (0.38)	1.46*** (0.25)
Reference Point for Loss Aversion Measure	**Purchase Price**	**Highest Over Holding Period**	**Highest Over Last 2 Years**
Loss aversion (relative to price index at purchase date)	-1.53 (2.92)		
Interaction: Loss aversion (relative to purchase price) x sold by institution	0.13 (2.91)		
Loss aversion (relative to highest price index over holding period)		-7.29*** (2.88)	
Interaction: Loss aversion (relative to highest price index over holding period) x sold by institution		2.11 (2.35)	
Loss aversion (relative to highest price index over past 2 years prior to sale)			-1.07*** (3.61)
Interaction: Loss aversion (relative to highest price index over past 2 years prior to sale) x sold by institution			1.53 (2.69)

Number of observations	5482	5482	5482
Log likelihood	-1498	-1499	-1502

Dependent Variable: Dummy variable of value = 1 if property is sold at auction and 0 else

Standard errors are in parentheses. All the models include year and neighborhood (postal area) dummies. Other variables included in the regression, but not shown here is interaction between loss aversion and low rise and dummy if unit is vacant.

***, ** and * denote significance level at 1%, 5% and 10% respectively.

Table 5B: Probability Property Will Be Sold at Auction – Institutional Sales Only (Logit for All Auction Attempts)

	(4)	(5)	(6)
	Institutional Sale Only		
Constant	1.28 (2.88)	-4.98 (3.30)	-4.46 (4.04)
Dummy: =1 if title is freehold	-0.0009** (0.0004)	-0.0009** (0.0004)	-0.0009** (0.0004)
# of previous auction attempts	-0.16*** (0.04)	-0.19*** (0.04)	-0.17*** (0.04)
Dummy: =1 if market prices have fallen for 2 successive quarters	0.59*** (0.20)	0.53*** (0.20)	0.59*** (0.22)
Price index at auction date	-0.02 (0.02)	-0.03 (0.03)	-0.03 (0.03)
Days from purchase to 1st auction date	0.0001*** (0.0001)		
Days from highest price over holding period to 1st auction date		0.0002* (0.001)	
Days from highest price over past 2 years prior to sale to 1st auction date			0.0002 (0.0001)
Dummy: =1 if unit is low rise structure	0.12 (0.39)	0.99* (0.52)	0.60 (0.46)
Dummy: =1 if unit is being sold by institution (foreclosure sale)			
Reference Point for Loss Aversion Measure	**Purchase Price**	**Highest Over Holding Period**	**Highest Over Last 2 Years**
Loss aversion (relative to price index at purchase date)	1.25 (1.02)		
Interaction: Loss aversion (relative to purchase price) x sold by institution			
Loss aversion (relative to highest price index over holding period)		5.81*** (1.96)	
Interaction: Loss aversion (relative to highest price index over holding period) x sold by institution			
Loss aversion (relative to highest price index over past 2 years prior to sale)			0.62 (2.89)
Interaction: Loss aversion (relative to highest price index over past 2 years prior to sale) x sold by institution			

Number of observations	4652	4652	4652
Log likelihood	-1323	-1322	-1325

Dependent Variable: Dummy variable of value = 1 if property is sold at auction and 0 else

Standard errors are in parentheses. All the models include year and neighborhood (postal area) dummies. Other variables included in the regression, but not shown here is interaction between loss aversion and low rise and dummy if unit is vacant.

***, ** and * denote significance level at 1%, 5% and 10% respectively.

5.0 Price Anomalies Observed in Auction

5.1 Background

Interest in auctions by economists has led to an entire sub-field of economics on auction theory. Most impressively, the theoretical findings in this area provide considerable practical guidance into auction construction and design. Housing is a fruitful area for empirical analysis of auction theory because houses are sold both by auction and negotiated sales. To date research has had a narrower objective of testing whether auction sales occur at a premium or discount. Answering the question whether houses sold at auction sell at a discount or premium has turned out to be surprisingly difficult. In some countries auction sales are unusual, raising concerns about left out variable bias in the estimation. Where they are more common, the decision to sell a house by auction is unlikely to be random, yielding selection bias.

In this paper we use auction data from Singapore that allows us to address aspects of excluded variable bias that is likely to be more prevalent in other studies of auction sales. As well, the mix of private transactions, auction sales, and foreclosure sales also enables us to identify the extent to which under-maintenance, asymmetric information, or bargaining power cause housing units sold because of foreclosure to transact at a discount. We also add an additional area of exploration, the role of auctions in price discovery. We examine whether there is any price anomaly for units that are not sold at *non-pooled* auction but subsequently sold through private negotiation. A price anomaly might suggest that the experience that bidders gained at the auction matters, hence leading to a price difference as compared to those who put up their sales directly through private negotiation.

Our contribution to the literature is three fold. First, with our auction data and ability to distinguish between institution and owner sale, we are able to provide a clearer understanding on the interaction between the winner’s curse associated with auction and the well documented finding on discount for foreclosed properties. Second, unlike auctions in US markets which are often associated with distressed properties, our auction data allows us to examine the differences in the extent of price premium/discount across two main types of sellers, essentially institution sellers of defaulted properties and owner-sellers who view auctions as an alternative sale mechanism. Third, by using condominium properties with building fixed effects we are not only able to control more effectively for unobserved variables, but also critically control for problems with under-maintenance and asymmetric information on unit quality in looking at foreclosure sales.

Our findings are quite intriguing. First, we find evidence of a price discount for auction sales, although the effect is only significant for high rise properties. However, if a unit is sold subsequent to the auction by private sale, it sells at a slight discount of 3 to 5 percent. It is not apparent that this could be due to an adverse price discovery process or that these properties are inferior or that the reserve price is too high. A higher discount is noted when the property that is subsequently sold is a foreclosed property.

Our results show quite clearly, that if one effectively controls for under-maintenance and asymmetric information concerns about unit quality for foreclosure sales, there is no foreclosure discount. In fact, foreclosed high rise properties (that are less prone to under-maintenance and asymmetric information) sell at a 3 percent price premium.

The next section provides some institutional information about auctions in Singapore. A description of the auction data, as well as market sale transactions is provided in the following section. This section also addresses the issue of index

The paper follows the standard structure. We follow a review of the literature with a discussion of auctions in Singapore and other details about the data. This is followed by our empirical findings. We conclude with a discussion of future research plans.

5.2 Literature

Auctioned properties may sell at a discount or premium to private negotiated sale. Surprisingly, there is no clear consensus on whether prices determined at auctions should be higher or lower than that obtained from private searches, both in theoretical and empirical research. A well known phenomenon of auctions is the winner’s curse, where under certain assumptions successful bidders pay more than an item’s expected market value. Mayer (1995) develops a theoretical search model with a monopolistic seller to show that a quick sale under the auction mechanism results in a poorer “match” between the buyer and the house. Consequently, the auction sale price would typically be at a discount compared to a private negotiated sale. In contrast, Quan (2002) develops a theoretical model that allowed for interaction between multiple sellers and the number of bidders where participants can choose between auction and negotiated sales. In this model there is a separating equilibrium between the two sales approaches based on seller and buyer discount rates and expected search times. Auction prices are higher because of reduced sales times.

The literature on housing auctions has not yielded a clear answer as to the sign and magnitude of an auction price effect. Work with US data (Mayer 1998, Allen and Swisher 2000, Quan 2002) finds that houses sold at auction are sold at a discount, while Ashenfelter and Genesove (1992) find a premium for auction sales in the US.[9] A key difference between the latter two papers, is that Quan sees this premium as compensation for benefits of seller reduced search costs in an auction and Ashenfelter and Genesove interpret their finding as evidence of the “winner’s curse.” In Australia, where auctions are quite a common sales mechanism, Lusht (1996) finds houses sold through privately negotiated sales had a 5.6 percent discount to houses sold at auction. Auctions are also an important sales mechanism in Scotland. Using Scottish data and modeling the first stage decision as to whether

[9] Ashenfelter and Genesove (1992) find a price premium relative for auction sales to buyers of units at the same New Jersey condominium complexes in later private negotiated sales for units whose sale at the auction fell through, leading to a subsequent negotiated sale.. However, the auction winners both get the units earlier, obtain units with certainty, but also win the “right to choose”. Quan suggests his result, which is contrary to his theoretical model, reflect sample selection bias in the decision to sell via auction.

to use the auction or private sales framework, Dehring, Dunse and Munneke (2005) do not detect significant price effect between the two alternative systems, although they find evidence of sample selection as in Lusht (1996).[10]

The problem in reaching any conclusions from this work is that we might believe in the US auctioned properties carry the stigma of being foreclosure sales or associated with them, while elsewhere, the first stage sample selection decision must be modeled. A precise comparison of the sales prices of auctioned and non-auctioned properties requires the measurement of a set of typically unobservable seller and unit characteristics. For distressed properties, unit quality, buyer risk assessment, and seller bargaining position. For units with accepted side by side auction and private sales mechanisms, the set of seller specific preferences and unobserved unit characteristics that cause a seller to select one or the other sales mechanism.

One approach for US auction data might be to back out the pure foreclosure effect from the aggregate auction effect. This would require a data set that included auction, foreclosed, and regular sales. Most studies document a discount for foreclosed properties (Shilling, Benjamin and Sirmans, 1990; Forgey, Rutherford and VanBuskirk, 1994; Hardin and Wolverton, 1996, Pennington-Cross, 2006)[11]. Two key reasons are offered for the discount. First, foreclosure sales are by definition defaulted loans and sellers are more likely to have negative equity

[10] Stevenson & Young (2004) find that the sales price for auctioned properties in Dublin, Ireland is statistically significantly higher greater than the advertised guide price for the property, which is not true for private treaty sale prices. This is consistent with, but not evidence of, a premium for auction sales, depending on the listing price strategies in the two markets.

[11] The Carroll, Clauretie and Neill (1997) analysis of HUD foreclosure sales is an exception.

resulting from larger relative price declines or because of cash flow problems the units may have not had have and under average maintenance. Even if the latter is not true, asymmetric information will price such a discount into a buyer’s offer. Second, sellers of foreclosed properties by definition are motivated sellers who either have a lower reservation price or have a weaker bargaining power and consequently are willing to accept lower prices.

The one surprisingly observation that emerges is that the two bodies of knowledge are developed almost independently, even though in the US, and thus for these papers, foreclosed properties are sold via auction or private sale (Pennington-Cross, 2006)[12]. Earlier foreclosure research such as Shilling, Benjamin and Sirmans (1990) and Forgey, Rutherford and VanBuskirk (1994) use MLS transactions of foreclosure properties. Hardin and Wolverton (1996) are silent on the sale mechanism for their foreclosure sales. Carroll, *et al.* (1995) examine HUD foreclosure sales, but it is not clear if these are through auctions. Given that foreclosed properties are expected to sell at a discount and that auctioned properties could sell at a premium, it remains a largely unanswered question as to whether it is better to sell foreclosed properties via the auction mechanism. This question is pertinent to foreclosing institutions as well as defaulted owners.

Allen and Swisher (2000) is a notable exception. They find that foreclosed properties sold through a HUD auction were sold at a discount. Curiously, the size

[12] Pennington-Cross (2006) notes that “… even within judicial states, the method by which the [foreclosed] property is sold varies…the property could be sold at a public auction, … or attorney sale, court appointed referee sales. Typical power-of-sale foreclosure sale include auction sales or trustee sales.” (page 200)

of the discount for the 160 foreclosed properties sold via auction over two days declines with the order of sale. It is possible that their finding is a result of the auction construct.

5.3 Data

This study utilizes auction data from Singapore from 1995 to 2006. These auctioned properties are a mix of foreclosed properties put up for sale by institutions and non-foreclosed properties put up for sale by owners. We take advantage of this difference to determine the existence of a foreclosure effect for auctioned properties. As well, because the auctions occur over a long time period, in contrast to most existing work, we can test for the stability of any auction or foreclosure effect and its relationship to market conditions.

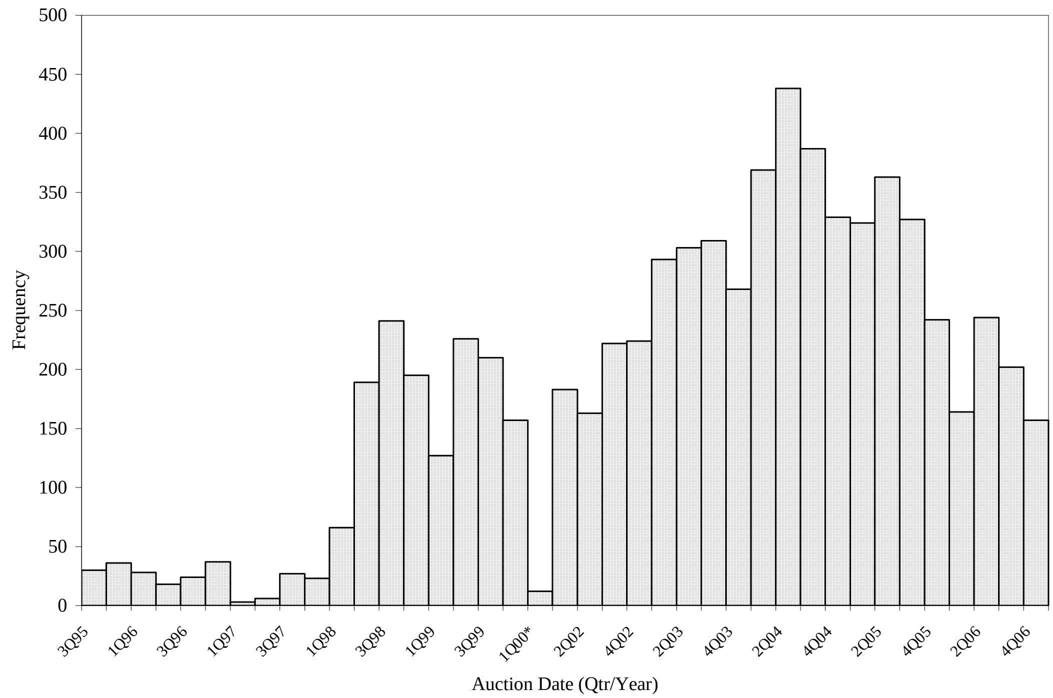
A key feature of this work is the control group of properties not sold though auctions. For units in high-rise condominium buildings we use sales from other units in the same structure, effectively using a building fixed effect. For units with individual title, principally attached units (low-rise), we use other sales in the same postal district, generating 28 neighborhood fixed effects.

An aspect of foreclosure sales that is important is the seller’s motivation. Does foreclosing mortgagee (lender) have an incentive to achieve the market price? In Singapore, foreclosing institutions (typically banks) have a duty of good faith to obtain the market price. This is not as strong as a fiduciary duty, so that the mortgagee is generally entitled to prefer his own interest (e.g. he may sell at the time he considers right) so long as he does not disregard the mortgagor's interests. Borrowers in Singapore are liable for negative equity in the event of mortgage default.[13] Consequently, the mortgagee is liable to legal action if a foreclosed property is sold at below market price, causing loss to the mortgagor. In Singapore, selling institutions have favored the auction mechanism as it insulates them from legal action by demonstrating that due process has been undertaken to obtain a fair price (Ong, 2006).

Figure 6 shows the pattern of auction attempts in Singapore. There was a surge in auction sales following the Asian financial crisis from 1998-1999.

[13] In Singapore, negative equity occurs when the sale proceeds net of repayment of the CPF principal sum plus CPF savings used to pay the legal costs, stamp duty and survey fees is *less* than the loan principal (CPF Residential Property Scheme). This policy has been amended since September 2002.

Figure 6: Auctions Attempts by Year



* 1Q00 only includes data on one month of the quarter

In this paper's current form, we apply a simple hedonic test, comparing sales prices for our units of interest with comparable units not sold via auction or by foreclosure. We define comparable units as follows: for high-rise units, other units sold in the same building or development, for low-rise units, other units sold in the same postal code. Among the high-rise properties, 326 properties are sold at the auction itself, 1,216 are sold through private negotiation after failure to sell at the auction, with 74,596 transactions of units in the same buildings not sold through auction. For low-rise buildings, 204 low-rise properties are sold at auctions, 673 sold through private negotiations after failure to sell at auction, and 221,480 are through private sales without attempting an auction.[14] For both cases, the matching units are limited to transactions within 18 months[15] prior or after the sale date of the units brought to auction.

We treat high-rise and low-rise properties separately to accommodate for the differences in explanatory variables and to adjust for heteroskedasticity. In both cases are explanatory variable list for the hedonic specification is quite small, floor area for the high-rise units, and lot-area for the low-rise units. Because we use building fixed effects, problems with left out variable bias should not be a problem for the high rise units, as controlling for unit size; unit quality will be quite homogenous within a given building. We recognize that with the low-rise units this is problematic. We present the results for the low-rise units as a comparison to the high-rise units, rather than a source of conclusive evidence on their own.

Tables 6A & 6B provide the summary statistics for the high- and low-rise properties used in the price regressions. The mean sale price is $5,370 per square meter of floor area for the high-rise units and $5,012[16] per square meter of lot area for the low rise properties. The average floor size for high-rise properties is 127 square meters and the mean lot size for low-rise properties is 358 square meters. Approximately one third of the high rise properties have a freehold tenure while low rise properties with freehold tenure constitute about 84% of the sample. 5% of

[14] There are many more low-rise sales, even though high-rise is the dominant form of structure in Singapore because the martching geography, one of the 14 postal districts in Singapore, is much larger than the criteria for the high-rise units, that they be in the same building.
[15] Various windows from 12 to 24 months were tried and 18 months was chosen as it gives a sufficient number of sample size for its comparables
[16] The figures shown are in Singapore dollars. US$1 = S$1.45

the high rise properties are newly built while 15% of the low rise properties are new.

Table 6A: Descriptive Statistics for Regressions on Log Sale Price – High Rise

	High Rise			
	Matched on full auction observations (Including those without subsequent sale)+++		Matched on auction observations with subsequent sale+++	
	Mean	Std Dev	Mean	Std Dev
Sale Price (Log)	3.73	0.16	3.71	0.18
Dummy: =1 if unit is put up at an auction	0.02	0.14	0.20	0.40
Dummy: =1 if unit is sold at auction	0.004	0.07	0.04	0.21
Dummy: =1 if unit is sold via PNS after failure to sell at auction	0.02	0.13	0.16	0.37
Unit floor area (m2)	126.89	52.03	131.90	75.68
Lot area (m2)				
Dummy: =1 if unit is being sold by institution (foreclosure sale)	0.02	0.13	0.16	0.37
Dummy: =1 if it has a freehold tenure	0.31	0.46	0.37	0.48
Dummy: =1 if the unit is new	0.05	0.22	0.02	0.14
State of market	0.63	0.48	0.69	0.49
Number of Observations	76,148		1,558	

All the models include year, property price index at the date of sale

+++ Comparables selected based on 18 months from the date of sale and/or subsequent sale

Our data includes also year, property price index at the date of sale neighborhood (postal area) dummies (low rise) and development dummies (high rise).

Table 6B: Descriptive Statistics for Regressions on Log Sale Price – Low Rise

	Low Rise			
	Matched on full auction observations (Including those without subsequent sale)+++		Matched on full auction observations (Including those without subsequent sale)+++	
	Mean	Std Dev	Mean	Std Dev
Sale Price (Log)	3.70	0.15	3.68	0.16
Dummy: =1 if unit is put up at an auction	0.004	0.06	0.07	0.25
Dummy: =1 if unit is sold at auction	0.001	0.03	0.02	0.13
Dummy: =1 if unit is sold via PNS after failure to sell at auction	0.003	0.05	0.05	0.22
Unit floor area (m2)				
Lot area (m2)	358.06	441.64	515.95	732
Dummy: =1 if unit is being sold by institution (foreclosure sale)	0.003	0.05	0.04	0.22
Dummy: =1 if it has a freehold tenure	0.84	0.36	0.88	0.32
Dummy: =1 if the unit is new	0.15	0.36	0.12	0.32
State of market	0.66	0.47	0.67	0.47
Number of Observations	222,362		3,819	

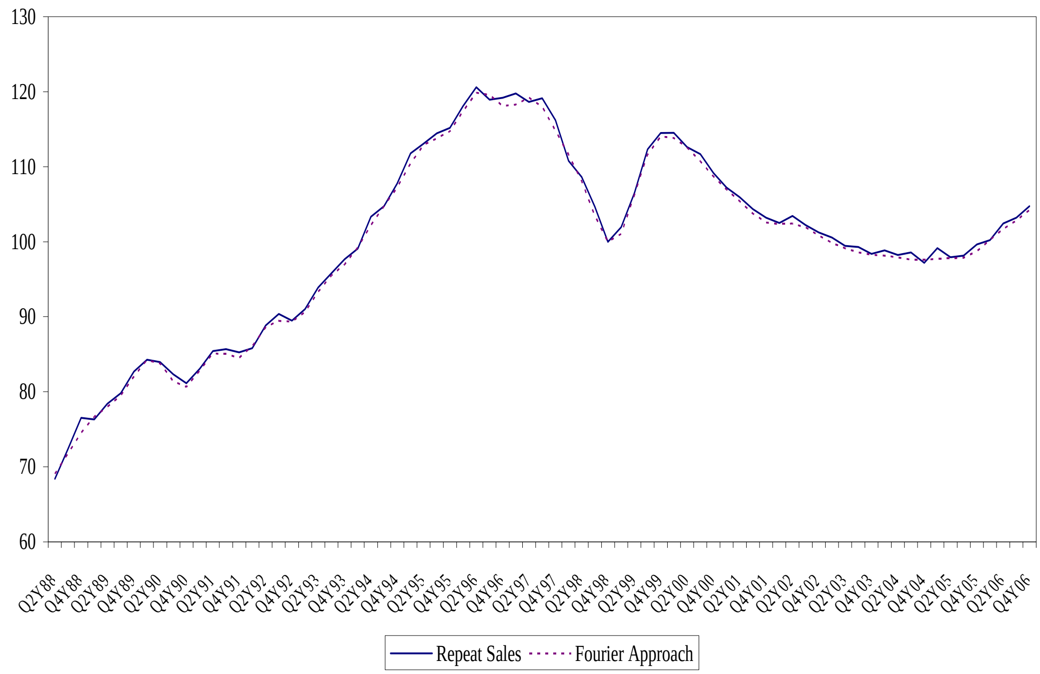
All the models include year, property price index at the date of sale

+++ Comparables selected based on 18 months from the date of sale and/or subsequent sale

Our data includes also year, property price index at the date of sale neighborhood (postal area) dummies (low rise) and development dummies (high rise).

We use a market price index to control for the state of the market. To do so we construct a traditional repeat sales price index as the readily available Urban Redevelopment Authority of Singapore (URA) price index does not control for house quality.[17] Figure 8 is the property price indexes for high and low rise properties.

Figure 8: Singapore House Price Indexes



We recognize that there may be a sample selection process by which sellers decide whether to bring a property to market or not. A theoretical framework for this process is laid out in Quan (2002) and it is formally incorporated into models by

[17] The repeat sales price index is calculated from 69,211 high-rise property repeat sales transaction pairs and 13,476 low-rise properties repeat sales transactions, both from 1989 to 2006, compiled using the Singapore Institute of Surveyors and Valuers (SISV) sales database.

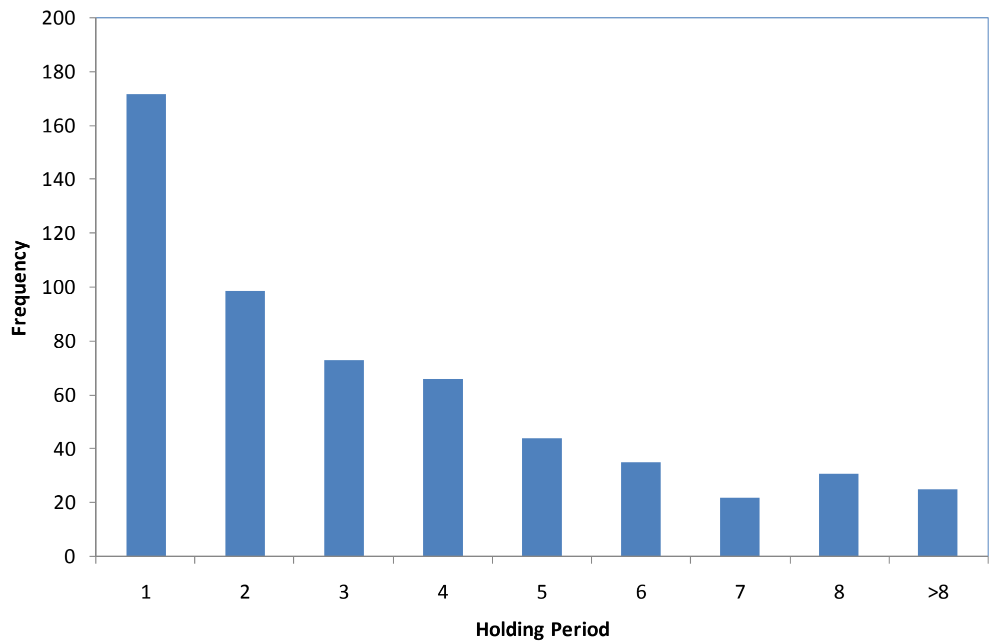
Lusht (1996) and Dehring, Dunse and Munneke (2005). We choose not to do so for several reasons. First, auctions represent such a low percentage of total transactions in Singapore that is hard to believe that any more than a small number of non-institutional sellers engage in a systematic choice between the two options. Second, the decision depends on both the unit and the owner. However, we have no variables describing the owner and the owner's wealth and cash flow positions, so that like Lusht, our identification in a first stage probit would derive entirely from the non-linear treatment of structure and location characteristics in this first stage, as opposed to a linear treatment in the second stage price equation. We do not find this to be consistent with a true selection process, where this is a measurable underlying systematic selection process at work.[18]

We use an alternative approach as a robustness test. In this approach, we use repeat sales sample. For the 2,419 properties that were sold either at auction or through private negotiation after failure to sell at auction, we traced their subsequent resale, if any, using the Singapore Institute of Surveyors and Valuers (SISV) sales database, which encompasses virtually all residential real estate transactions in Singapore since 1988. We have 567 properties with subsequent sale, of which 318 are high rise properties. Figure 9 shows the holding period from the sale at auction/private negotiation after failure to sell at auction to its subsequent resale. The largest mass is for the 172 properties sold in the first year after its first sale at

[18] We did as an experiment use a two stage process with a probit and an inverse Mills ratio. This did not have a meaningful effect on our parameter estimates.

auction/private negotiation. The highest holding period in our sample is close to 11.5 years.

Figure 9: Number of Days from 1st Sale to Subsequent Sale (Only Include Properties Put Up for Auction Sales – Without Comparables)



5.4 Results

Our first test is an OLS hedonic price model for which we estimate the price function for separately for high and low rise properties.[19] For each we segment the sample into those units that will be part of a later analysis of price changes, so they

[19] All regressions include either building dummies (high-rise) or postal district dummies (low-rise), the Singapore wide property price index, and year dummies.

are matched sales. The results as presented in Table 7 show that high rise properties sold at the auction had a statistically significant *lower* price. For low rise properties, the coefficient is negative, but not statistically different than zero. This result reinforces similar findings from many earlier papers.

Table 7: Regressions Results on Log Sales Price (price per m^2)

	High Rise		**Low Rise**	
	Sales with/without Subsequent Resale	Sales with Subsequent Resale	Sales with/without Subsequent Resale	Sales with Subsequent Resale
Constant	**2.52*** (0.02)**	**2.67*** (0.14)**	**2.55*** (0.01)**	**2.74*** (0.05)**
Dummy: =1 if unit is sold at auction	**-0.09*** (0.02)**	-0.05 (0.03)	-0.02 (0.05)	-0.02 (0.05)
Dummy: =1 if unit sold via private negotiated sale after failure to sell at auction	**-0.03*** (0.02)**	**-0.03*** (0.02)**	**-0.05*** (0.001)**	**-0.05*** (0.01)**
Dummy: =1 if unit is sold by institution (foreclosure)	**0.03* (0.02)**	0.02 (0.04)	-0.03 (0.03)	-0.02 (0.05)
Interaction: Units sold via private negotiated sale after failure to sell at auction x institution (foreclosure) sale	**-0.04*** (0.02)**	-0.04 (0.04)	0.03 (0.03)	0.01 (0.05)
Unit floor area	**-0.0005*** (0)**	**-0.0004*** (0)**		
Lot area			**-0.001*** (0)**	**-0.0001*** (0)**
Dummy: =1 if it has a freehold tenure	**0.11*** (0.001)**	**0.11*** (0.01)**	**0.09*** (0.001)**	**0.06*** (0.01)**

Dummy: =1 if the unit is new	**0.08*** (0.002)**	**0.05*** (0.02)**	**0.11*** (0.001)**	-0.01 (0.02)
Dummy: =1 if market prices have fallen for 2 successive quarters	0.001 (0.001)	0.002 (0.01)	-0.01*** (0.001)	**-0.01*** (0.004)**
Number of Observations	76148	1861	222362	5564
R-Squared	0.89	0.87	0.45	0.43

Price for high rise is per m^2 of floor area, for low rise per m^2 of lot area.

Standard errors are in parentheses. All the models include year, property price index at the date of sale and neighborhood (postal area) dummies and low rise properties include property type dummies.

***, ** and * denote significance level at 1%, 5% and 10% respectively

One of the advantages our data has is the use of condominium properties with other units in the same building acting as a control. First, given that we have unit size and look at price per m^2, this is an effective control for unobservables.

Second, this effectively addresses part of the problem with unobserved structure and unit quality. All units share the same structure, and even if an owner is behind on condominium fees, they still benefit from the council's expenditure on the structure and public areas. As well, within internal unit quality is unlikely to exhibit substantial cross-unit variation beyond that captured by unit size, as all units were built at the same time and to the same quality level; renovation being much more difficult and addition impossible for units in a multi-unit structure. This control is particularly useful in looking at foreclosure. One of the assumptions in the literature on foreclosure is that the lower values reflect under-maintenance, and other problems with these units, and concern about a “lemon’s problem.” The multi-family units with building fixed effects should eliminate nearly all of these concerns, leaving only a pure foreclosure effect of either stigma or the seller’s stronger desire to sell the unit.

The foreclosure results are quite striking. For multi-family units, foreclosure sales at auction essentially sell a higher price as any other unit. In contrast, foreclosed low rise properties, where under-maintenance and asymmetric information on unit quality are an issue, sell at a discount, albeit the effect is statistically insignificant. This suggests that the pure foreclosure effect in the absence of under-maintenance and asymmetric information is a positive one, supporting the framework in Quan (2002). Comparing the two suggests an under-maintenance effect of approximately 4 percent.

The third element we examine is the subsequent sale by private negotiated sale of units that did not transact at the auction. When these units are sold, they transact at a 3 to 5 percent lower price, a difference that is statistically different from zero. As this discount is statistically different from the auction price discount, it appears that either the price discovery process adversely affects these units, or that these units are inferior and hence do not sell at auction. The interaction term between the units not sold at the auction but sold subsequently by private sale with institution (foreclosure) sale is statistically significant and negative only for high rise properties. However, for low-rise sales it does suggest institutions can get a higher price in subsequent negotiations, although the effect is statistically insignificant.

6.0 Are “Anomalies” Anomalies? Evidence from Repeated Auction Attempts

6.1 Background

There are some critiques to behavioral economics and finance. One of the fiercest critics in behavioral finance literature is by Fama (1998) who contends that “market efficiency survives the challenge from the literature on long-term return anomalies”. Consistent with the market efficiency hypothesis that the anomalies are chance results, he claims, that apparent overreaction to information is about as common as underreaction, and post-event continuation of pre-event abnormal returns is about as frequent as post-event reversal. More importantly, consistent with the market efficiency prediction that apparent anomaly can be due to methodology, most long-term anomalies tend to disappear with reasonable changes in technique.

As demonstrated in the earlier sections, the evidence of “anomalies” came from results involving one-off decisions. This thesis further attempts to ask “Will these ‘anomalies’ still arise or persist in repeated market?” In this section, we will focus on loss aversion and the question to ask is basically “Whether loss aversion dissipates with repeated auctions?”

6.2 Literature

To my knowledge, few researches undertake to study human behavior in repeated market environment and all of them use experiments. Several studies have examined the effect of endowment over repeated market trials. However, the experimental results are not conclusive.

Kahneman et al. (1990) found that the disparity between buying and selling values does not diminish over numerous repeated market iterations. However, two studies have found that if values are elicited using the Vickrey auction, the disparity disappears with repetition (Harless, 1989 and Shogren et al. 1994). Shogren et al (1994)’s finding suggests that repeated trials provide the discipline to help subjects learn their true valuations through interactions with the market

Further work by Plott (1996) in his discovered preference hypothesis also suggests that rationality is a process of discovery’: when individuals face unfamiliar tasks, their behavior can be influenced by various biases, but with incentives and practice, they arrive at ‘considered choices’ that reflect stable underlying preferences (Plott, 1996, p.248). Following Plott, Loomes el al. (2003) introduce a refining hypothesis which states that “if preferences satisfy standard consistency requirement, and if anomalies result from errors, this refining hypothesis predicts a tendency for anomalies to become less frequent as market experience accumulates. This hypothesis does not specify the mechanisms which promote error reduction.

Some economists have argued that anomalies behavior is economically significant only if it survives in an environment in which individuals repeatedly face the same decision problem (Buttimore, 1994, 1999). However the current literature based on experiments is not able to provide a conclusive result on the anomalies behavior. Hence this thesis attempts to bridge the knowledge gap of whether these anomalies behavior diminish in repeated market environment, using actual market data in Singapore.

6.3 Three Alternative Hypotheses of Learning in Repeated Markets

Loomes, Starmer and Sugden (2001) consider three alternative hypotheses about how people learn in the repeated markets.

6.3.1 Refining hypothesis

The refining hypothesis states that market experience helps individual to make decisions that more accurately reflect their preferences. If preferences satisfy standard consistency requirements and anomalies result from errors, the refining hypothesis predicts a tendency for anomalies to become less frequent as market experience accumulates. Individuals refine their decision making ability through repetition, feedback and incentives. Repetition allows subjects to experience the consequences of particular choices; incentives provide a general motivation to attend to tasks carefully.

6.3.2 Market discipline hypothesis

The market discipline hypothesis assumes that agents have stable underlying preferences and that they may commit errors when attempting to act on those preferences within a market institution. However, the market discipline hypothesis distinguishes between two types of errors: those which, ex post, are costly to the agent once the market outcome is known and those which are not. The hypothesis is that agents adjust their behavior to correct errors if and only if those errors have proved costly.

6.3.3 Shaping hypothesis

The shaping hypothesis states that, in repeated market environments, there is a tendency for agents to adjust their bids towards the price observed in the previous market period.

In the experiment, subjects took part in a series of repeated auctions. All of the auctions were median price auctions which operated as follows. Each involved an odd number of participants, and a computer program elicited a bid from each subject equal to the price which they were just not willing to trade. The medium bid was then computed and announced as the market price. The program implemented all trades consistent with subjects’ bids at the market price. So, in buying auctions, only subjects with bids above the market price bought; in selling auctions, only subjects with asks below the market price sold. The mechanism was a sealed bid, but subjects learned the market price, whether they had bought or sold, immediately at the end of each auction round. Their findings were consistent with the shaping hypothesis. The authors conclude: “The discovery of a shaping effect has potentially far-reaching theoretical consequences. For example, claims concerning the efficiency of competitive markets typically assume that preferences are independent of market activity. If it were the case that values are ‘contaminated’ by price feedback through market participation that would warrant serious reconsideration of the foundations of standard economy theory.”

6.4 Methodology

To examine whether loss aversion will dissipate with repeated auction, we are extending the data and the two approaches used in Section 4. The first approach is to use OLS regression to study the effect of loss aversion on a unit’s sale price, either the price that the properties are sold either at the auction itself or via private negotiated sales after failure to sell at the auction. The second approach is to test a variant of probability of sale analysis, whether a unit is sold at auction or not. The sample is separated into sub-sample. One set consists of those with no repeat sales and another set consists of those with repeated sales regardless the number of repeated attempts. In addition, we also tested the sub-sample with one repeated auction attempts to determine whether the greater the number of auction attempts, the lesser the adversity of loss.

6.5 Results

The results for both Tables 8A and 8B and Table 9 on loss aversion variable all indicate that loss aversion only exists in the first auction (Column 1 of Tables 8A, 8B and 9). Interestingly, this supports the research that anomalies do disappear with repeated auctions. However, the results in Column 2 of the three tables indicate that adversity of loss is independent of the number of auction attempts.

Table 8A: Regressions on Log Sales Price (High Rise) – Repeated Auctions

	(1)	(2)	(3)
	Prevatt=0	**Prevatt=1**	**Prevatt>0**
Constant	5.95*** (0.05)	6.06*** (0.11)	5.92*** (0.09)
Dummy: =1 if market prices have fallen for 2 successive quarters	-0.04 (0.03)	-0.13* (0.07)	-0.09 (0.05)
Days from Reference Point to 1st Auction Date	0.00003* (0.00002)	0.00001 (0.00003)	0.0000002 (0.00002)
Days from 1st Auction Date to Eventual Sale	0.00001 (0.00002)	0.00003 (0.000002)	0.00002 (0.00002)
Dummy: =1 if unit is being sold by institution (foreclosure sale)	-0.08** (0.04)	-0.10 (0.08)	-0.15** (0.07)
Dummy: =1 if unit is sold at auction	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Dummy: =1 if unit is sold at 1st auction	0.02* (0.01)	0.04* (0.03)	0.03* (0.02)
Change in housing price index from1st auction to eventual sale dates	1.35*** (0.23)	1.03*** (0.25)	0.69*** (0.17)
Reference Point for Loss Aversion Measure	**Highest Over Holding Period[20]**		
Loss aversion measure	1.29* (0.71)	0.05 (1.28)	0.29 (1.05)
Interaction: Loss aversion x sold by institution	-0.82 (0.64)	-0.39 (1.37)	-0.68 (1.08)
Loss aversion^2	-3.74* (2.18)	-2.16 (4.75)	-1.88 (3.79)
Interaction: Loss aversion^2 x sold by institution	2.68 (2.23)	1.34 (4.99)	0.92 (3.86)
Number of Observations	914	311	716
R-Squared	0.54	0.67	0.59

Standard errors are in parentheses. All the models include year and neighborhood (postal area) dummies; hedonic variables include whether unit is vacant, title is freehold, unit size (high-rise only), and lot size (low rise only) but are not in the table.

***, ** and * denote significance level at 1%, 5% and 10% respectively

[20] Similar conclusion holds when the reference point for loss aversion is taken to be the highest over the last 2 years

Table 8B: Regressions on Log Sales Price (Low Rise) – Repeated Auctions

	(4)	(5)	(6)
	Prevatt=0	**Prevatt=1**	**Prevatt>0**
Constant	5.76*** (0.07)	5.80*** (0.11)	5.84*** (0.08)
Dummy: =1 if market prices have fallen for 2 successive quarters	-0.002 (0.02)	-0.04 (0.03)	-0.03 (0.02)
Days from Reference Point to 1st Auction Date	-0.00002 (0.00002)	-0.00004 (0.00003)	-0.00002 (0.00002)
Days from 1st Auction Date to Eventual Sale	0.00002 (0.00002)	0.00001 (0.00004)	0.00002 (0.00002)
Dummy: =1 if unit is being sold by institution (foreclosure sale)	-0.09* (0.06)	-0.09 (0.10)	-0.10 (0.07)
Dummy: =1 if unit is sold at auction	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
Dummy: =1 if unit is sold at 1st auction	-0.02 (0.02)	-0.04 (0.03)	-0.04** (0.02)
Change in housing price index from1st auction to eventual sale dates	0.91*** (0.23)	0.72** (0.30)	0.24 (0.14)
Reference Point for Loss Aversion Measure	**Highest Over Holding Period**[21]		
Loss aversion measure	2.80*** (0.88)	1.22 (1.36)	0.89 (1.00)
Interaction: Loss aversion x sold by institution	-2.36*** (0.81)	-1.25 (1.54)	-1.24 (1.05)
Loss aversion^2	-10.79*** (2.68)	-4.79 (4.87)	-3.22 (3.66)
Interaction: Loss aversion^2 x sold by institution	9.02*** (2.78)	4.63 (5.53)	5.06 (3.44)
Number of Observations	530	179	356
R-Squared	0.68	0.76	0.75

Standard errors are in parentheses. All the models include year and neighborhood (postal area) dummies; hedonic variables include whether unit is vacant, title is freehold, unit size (high-rise only), and lot size (low rise only); and auction variable is # of previous auction attempts but are not in the table.

***, ** and * denote significance level at 1%, 5% and 10% respectively

[21] Similar conclusion holds when the reference point for loss aversion is taken to be the highest over the last 2 years

Table 9: Probability Property Will Be Sold at Auction – All Sample (Logit for All Auction Attempts) – Repeated Auctions

	(1) Prevatt=0	(2) Prevatt=1	(3) Prevatt>0
Constant	-7.25* (4.28)	-2.42 (5.32)	-0.65 (4.75)
Dummy: =1 if title is freehold	-0.001* (0.0005)	-0.001 (0.001)	-0.002** (0.0001)
# of steps in auction bidding			-0.02 (0.04)
Dummy: =1 if market prices have fallen for 2 successive quarters	0.55** (0.24)	1.59*** (0.48)	0.71** (0.31)
Price index at auction date	-0.09** (0.04)	-0.005 (0.04)	-0.03 (0.04)
Days from purchase to 1st auction date	0.001*** (0.0002)		
Days from highest price over holding period to 1st auction date		0.0001 (0.0003)	
Days from highest price over past 2 years prior to sale to 1st auction date			0.0004* (0.0002)
Dummy: =1 if unit is low rise structure	1.45** (0.70)	0.05 (0.94)	0.18 (0.73)
Dummy: =1 if unit is being sold by institution (foreclosure sale)	1.91*** (0.46)	0.37 (0.99)	0.23 (0.83)
Reference Point for Loss Aversion Measure	**Highest Over Holding Period**		
Loss aversion (relative to price index at purchase date)	-8.61* (4.57)		
Interaction: Loss aversion (relative to purchase price) x sold by institution	1.80 (2.84)		
Loss aversion (relative to highest price index over holding period)		-15.27 (9.95)	
Interaction: Loss aversion (relative to highest price index over holding period) x sold by institution		0.88 (4.27)	
Loss aversion (relative to highest price index over past 2 years prior to sale)			-7.83 (6.15)
Interaction: Loss aversion (relative to highest price index over past 2 years prior to sale) x sold by institution			6.96 (5.31)

Number of observations	2715	1138	2767
Log likelihood	-889	-255	-571

Dependent Variable: Dummy variable of value = 1 if property is sold at auction and 0 else

Standard errors are in parentheses. All the models include year and neighborhood (postal area) dummies. Other variables included in the regression, but not shown here is interaction between loss aversion and low rise and dummy if unit is vacant.

***, ** and * denote significance level at 1%, 5% and 10% respectively.

7.0 Conclusions

Broadly, this thesis attempts to extend the current literature to give a better understanding of loss aversion in housing market. And secondly, it also attempts to examine the price anomaly in real estate auction. Lastly, it intends to bridge the knowledge gap by examining whether observed price “anomalies” diminish in a repeated market environment.

This thesis is motivated based on the greater difficulty of standard economic theory to understand individual choice behavior. In standard economic theory, it relies on expected utility maximization, which implies that economic agents are capable of correctly identifying and maximizing their utility functions. It also assumes unlimited information processing capabilities. In other words, economic agents are rational. For instance, economic theory predicts that the prices that a person will pay to buy and sell an object should be about the same. But numerous experiments have shown that there is a large disparity between selling and buying prices. These are usually term as “anomalies” in economic theory. These “anomalies” depart from the optimal judgment and decision making.

In the recent years, there are numerous efforts to capture psychologically more realistic notions of human nature into economics and finance. This is commonly labeled under the rubric “behavioral economics” and “behavioral finance.” The goal of psychological economics and finance is to investigate behaviorally grounded departures from these assumptions that seem economically relevant.

This thesis is mooted on the individual choice behavior by providing it with more realistic psychological foundations. It is based on the behavioral economics theories.

An important groundwork on behavioral economics came from the prospect theory. The theory is developed by Kahneman and Tversky in 1979. It is this theory that paved the development of behavioral economic and finance. The theory showed how judgement under uncertainty departs from the assumption of rationality. Unlike expected utility theory, prospect theory is descriptive and developed in an inductive way from empirical observations. Basically, individuals maximised weighted sum of utilities, which are determined by what Kahneman and Tversky call “value function”

There are three main differences between the value function in prospect theory and utility function in expected utility theory. First, unlike utility function which is concerned with final values of wealth per se, prospect theory is concerned with changes in wealth, relative to a given reference point. Second, the slope of value function is asymmetric between gains and losses; the value function declines more for a given loss than it rises for a gain of the same amount. That is it is concave for gains and convex for losses. However, for utility function, the slope is smooth and concave throughout. Third, for both gains and losses, the marginal value for a change in wealth declines with the magnitude of the change. That is, people behave as if they regard extremely improbable events as impossible and extremely probable events as certain.

As mentioned earlier, one of the thesis objectives is to provide a greater understanding of loss aversion in housing market. Loss aversion is proposed by Kahneman and Tversky (1979) in their prospect theory. This is based on the idea that the mental penalty experienced by an individual or agent associated with a given loss is greater than the mental reward from a gain of the same size. If investors are loss averse, they may be reluctant to realize losses.

Hence unlike the utility function in expected utility theory which is taken to be smooth and concave everywhere, the value function in the prospect theory is S-shaped. It is concave for gains and convex for losses, displaying diminishing sensitivity to change in both directions. Furthermore, it has a kink at zero, being steeper for small losses than for small gains.

So far, many works have been done for loss aversion. However, they are all experimental studies. For instance, the experimental work by Knetsch (Knatch) and Tversky and Kahneman support loss aversion.

Given that the works on loss aversion are carried out using experiments, the results are hence sensitive to:

(1) Who participates and nature of instructions

(2) The types of auction

In the housing market, the research of loss aversion is very limited. The first paper on loss aversion in the housing market is by Genesove and Mayer (2001). Using data on Boston condominium sales, they find that house owners are loss averse using transaction and list prices and time to sale. They also find that loss aversion is not a uniform aspect of participants in housing markets. Basically, investors exhibit less loss aversion than owners.

An often-noted characteristic of housing markets that sets them apart from other asset markets is the positive correlation between housing prices and transaction volume. Stein (1995) argues that credit market imperfections that impose downpayment constraints on buyers can explain this phenomenon. In contrast, Engelhardt demonstrate that loss aversion as an alternative explanation for this phenomenon.

The housing market is a fruitful place to test loss aversion because it is an infrequently traded asset. Unlike common goods such as pens and mugs, a person only gets to buy or sell a property few times in their life. Furthermore, housing is held for both investment and consumption purposes. The transaction data also allow researchers to identify asset acquisition and disposition dates and hence losses are measurable, which has been the challenge for other asset classes.

This thesis uses auction data on housing from Singapore. Auction mechanisms have been extensively used as it provides an excellent platform for a better understanding of human behavior. Unlike many other studies that use experiments, the data set used in this thesis are actual auction data.

In the first part of the thesis, there are two research questions that attempts to examine on loss aversion. Firstly, what is the relevant reference point for evaluating losses in a prospect theory framework? Secondly, how does the sensitivity to loss vary across different types of sellers?

The first part of the thesis attempts to make two primary contributions to the literature. First, we provide empirical evidence on the relevant reference point for prospect theory, specifically we examine whether losses are evaluated relative to the acquisition prices or the highest possible price the owner could have received over the holding period/recent past.

Second, we examine whether there are differences in the extent of loss aversion across types of sellers. Genesove and Mayer (2001) compare owner-occupiers and investors; we extend this to look at the difference between individual (owners) sellers and institutional sellers. Institutional sellers are expected to be less sensitive to loss aversion than are individuals, be it they are more experienced or less emotionally connected to the unit. Individual sellers, on the other hand, are expected to be loss averse.

Our results suggest that loss aversion is evident. Probably our most robust result is that the relevant reference point for measuring the change in the value function is not the initial nominal purchase price, but rather the highest value. There are strong evidences for the reference points to be both the highest price and highest price over the most recent past. Our other findings include that institutions are less susceptible to loss aversion than individuals. Both prices and time to sale time to sale increase more for individuals than for institutions as the likely loss increases. Like Genesove and Mayer (2001) we get a clear positive relationship between potential loss and the time to sale, where we measure this in a duration framework as the hazard for the probability of sale. We also find that loss aversion is not present for all sellers in housing markets. The motivated sellers do not hold out for higher prices. However, they do take longer to sell their units. A more robust finding is that experienced sellers, that is, institutions selling foreclosed units, are less affected by loss aversion than are individuals.

The second part of the thesis focuses on the price anomalies observed in auction. Ashenfelter and Genesove (1992) attributed their findings for price premium as evidence of the "winner's curse." Winner's curse is a phenomenon where under certain assumptions, successful bidders pay more than an item's expected market value. On the other hand, Mayer (1995) attributed the discount to be the quick sale under the auction mechanism that results in poorer match between the buyer and house.

Foreclosed properties are usually sold at a discount (Shilling et al., 1990; Forgey et al., 1994; Hardin and Wolverton, 1996, Pennington-Cross, 2006). Hence, one problem in reaching any conclusion from this work might be the difficulty of differentiating the stigma of foreclosure associated with auctioned properties. As the auction data from Singapore consists of both sales by institution and individual owner, this thesis will be able to back out the pure foreclosure effect from the aggregate auction effect. This will provide a clearer understanding on the interaction between the winner’s curse associated with auction and the well documented finding on discount for foreclosed properties.

The research questions that the second part of the thesis attempts to examine include (1) Is there any interaction between the phenomenon of expected premium at auction and discount for foreclosed properties; (2) Is price premium/discount uniform across market participants? Any differences due to bargaining power? (3) Between high and low rise properties, what is the extent of under-maintenance and asymmetric information that cause foreclosed properties to transact at a discount, that is, is there pure discount for foreclosed properties? (4) In the price discovery process, is there any price anomaly for units that are not sold at non-pooled auction but subsequently sold through private negotiation? Has bidders gained experience at auction?

The results shed clear light on the existence of a premium or discount for auction sales, but also the relationship between under-maintenance and asymmetric information on unit quality and the price of units sold at foreclosure.

The third part of the thesis looks into whether anomalies behavior survives in a repeated market environment. In behavioral economics and finance, many anomalies behavior have been found but it is a one-off decision. Hence, some economists question the reliability of the findings as there are also some findings that showed the patterns of behavior that conformed to the standard economic theory. Hence, some economists have thereby argued that anomalies behavior is significant if it survives in an environment in which individuals repeatedly face the same decision problem (Binmore, 1994 and 1999).

In this section, we will focus on loss aversion and the question to ask is basically “Whether loss aversion dissipates with repeated auctions?” We are extending the section on loss aversion to further examine this research question. Interestingly it is found in our research that anomalies do disappear with repeated auctions. However, the adversity of loss is independent of the number of auction attempts.

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Appendix A

Define a unit’s i log market value at time t as P_{it}, and the current log market index as P_t . The observed transaction price of an individual unit depends on both the current market, the unit’s quality/quantity deviation from the market index, and the outcome of bargaining process between the buyer and seller v_{it}. We assume that the price of the housing services delivered from the unit’s structure is a function of observable characteristics $\beta(X_i)$ and unobserved quality e_i. For convenience we assume that both are time-invariant relative to the market index. We assume further that both e and v are distributed with mean zero and each with its own variance. The observed transaction price of unit i at time t become:

$$P_{it} = P_t + \beta(X_i) + e_i + v_{it}. \qquad (1)$$

Loss at time $_t$ L_{it} is defined as maximum of zero and the expected price at the reference point minus the current expected value. So for a reference point of the unit’s value at time 0:

$$L_{it} = \max\{0, E(P_{i0}) - E(P_{it})\}. \qquad (2)$$

Substituting from (1) into (2):

$$L_{it} = \max\{0, E(P_0 - P_t) + (\beta(X_i) - \beta(X_i)) + (e_i - e_i) + E(v_{i0} - v_{it}).\} \tag{3}$$

Eliminating the time invariant components reduces to an expression of the market index and the seller's bargaining strength at times *0* and *t*.

$$L_{it} = \max\{0, E(P_0 - P_t) + E(v_{i0} - v_{it})\}. \tag{4}$$

If we impose the assumption that a seller expects her relative bargaining skill to be constant over time, so that in the population v_{it} is mean zero, but individual *i* has E(v_{it}) = E($v_{i,t+j}$), then the expected change in the price index will measure an owner's expected loss aversion between any two dates. L_{it} will thus be a function of actual price index values for any analysis of loss aversion that involves current and past dates.